Graham Edgar

Marine Life and Potential Marine Reserves in Tasmania

Part 2

National Parks and Wildlife Service, Tasmania
Occasional Paper No. 7

MARINE PARKS AND POTENTIAL MARINE RESERVES IN TASMANIA PART 2

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Cover photo:

Sea horse *(Hippocampus abdominalis)* attached to *Macrocystis pyrifera* at Waubs Bay, Bicheno.

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MARINE LIFE AND POTENTIAL MARINE RESERVES IN TASMANIA PT. 2

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SURVEY SUMMARY

1. The assemblages of marine plants and animals which occur in the Kent Group, along the south-western Tasmanian coast, and in the vicinity of Bicheno, are described.

2. The Kent Group appears to have a much greater number of Peronian (New South Wales) marine species than other localities in Tasmania.

3. The marine flora and fauna found along the southern Tasmanian coast is depauperate compared to that found elsewhere in the State.

4. A benthic faunal assemblage is present in unusually shallow water in Bathurst Channel.

5. It is recommended that : -

(i) a Nature Reserve, extending offshore for a distance of 2 km, be declared in the Kent Group,

(ii) a Nature Reserve be declared near Bicheno to include Governor Island and a marine extension which encompasses the submerged lands eastward for a distance of 300 m, and

(iii) the previously proposed Woodbridge marine reserve not be proceeded with.

1. GENERAL INTRODUCTION

As a result of such tragedies during the past few decades as the outbreak of mercury poisoning at Minimata Bay and the collapse of the Peruvian anchovy fishery, the human race is increasingly recognising that the world's oceans represent neither an unlimited sink for pollutants nor an inexhaustible source of food. One of the great remaining problems for humanity is the need to identify methods to properly conserve and manage marine resources. This problem is exacerbated in Tasmania by the very limited knowledge about what plants and animals exist in our local waters. More baseline information is needed on the composition and distribution of Tasmanian marine communities, particularly those assemblages present in the heavily exploited, shallow coastal waters. Concurrent with this collection of information is the need to set aside limited areas where the biota is protected. These areas will act as a safeguard in case present management techniques fail. Benefits additional to the conservation of marine resources would also result from such "marine reserves". These benefits include -

(i) the increased fish stocks in the reserve would provide a source of eggs, larvae and adults which would partly be available for capture outside the reserve;

(ii) genetic diversity would be maintained, and thus there would be a slowing of such trends as rock lobsters maturing earlier and growing slower with each generation because fast growing individuals are selected against by being caught at a relatively early age by fishermen as the animals reach minimum size.

(iii) the recreational attraction of the area for visitors, particularly naturalists, photographers and divers, would be increased as well as safeguarded;

(iv) the large number of divers attracted to a marine reserve would require accommodation and ancillary services, and thus bring economic benefits to nearby towns;

(v) a scientific reference area would exist so that changes in adjoining exploited areas could be monitored, and

(vi) there would be a focal point for educational programmes about the conservation and management of marine resources.

The need for marine reserves is particularly urgent in Tasmania for a number of reasons.

(a) Tasmania comprises the core area of the Maugean marine province, one of the smallest of the world's provinces. Consequently, unlike tropical Australia where almost all marine species range widely (generally throughout the Indo-Pacific region), species in Tasmania often have very localised distributions and may not occur in the waters of the mainland states. An extreme example of the restricted distributions of some Tasmanian organisms is shown by the sea star *Patiriella vivipara* which occurs in the intertidal zone at only three very limited areas in south-eastern Tasmania and would occupy a total area not exceeding 3 hectares. The survival of such localised species is totally dependent on proper management by Tasmanian authorities.

(b) Gill-net fishing is widespread by both amateur and professional fishermen in Tasmanian waters. The use of gill-nets is severely restricted in other Australian states because these nets catch most of the larger rocky reef fish species. When placed in large numbers on individual reefs, gill-nets drastically reduce fish abundances and modify the community structure. Problems also arise when gill-nets are insufficiently weighted and drift from where they are set. These "ghost" nets continue to catch and kill fish, and sometimes rock lobsters, for months afterwards.

(c) The pressure on fish stocks, particularly by amateur fishermen, is increasing rapidly. During the 10 year period from 1970 the number of non-commercial diving licences (for the taking of abalone, rock lobster and scallops) issued by the Tasmanian Fisheries Development Authority almost quadrupled (from 794 to 2974), while the number of rock lobster pot licences rose from 2916 to 7181.
As the waters close to population centres and camping areas become overexploited, fishermen need to move further afield to find reefs with reasonable populations of fish. This has important consequences for marine reserves; (i) it drastically reduces fish numbers in potential marine reserves, decreasing the justification for their creation and reducing the area from which marine reserve sites can be

selected, and (ii) fishermen then consider these areas traditional fishing grounds and there is increased opposition to their proclamation as reserves.

(d) Coastal areas of Tasmania are deteriorating as a result of industrialisation, pollution, the siltation of rivers and foreshore development, particularly along the northern and eastern coasts.

It is notable that Tasmania is the only State of Australia without marine reserves. Seven marine reserves exist in New South Wales (including a marine extension to the Bouddi National Park), 11 aquatic reserves in South Australia, the Great Barrier Reef Marine Park and 23 fish habitat reserves in Queensland, the five Harold Holt marine reserves in Victoria, and four fisheries reserves plus the recently proposed Ningaloo Marine Park (expected to cover 260 km of coast) in Western Australia. Marine reserves also exist in Australia's offshore territories, the Northern Territory and New Zealand.

In order to obtain basic information on the plants and animals present along the Tasmanian coast, and to assess in a systematic manner potential marine reserve sites, a series of marine surveys was initiated in 1980. The first of these surveys was restricted by time limitations to the northern and eastern Tasmanian coasts, and to the Furneaux Group of islands. The results of that investigation, and a number of recommendations for marine reserves, were given in an earlier publication (Edgar, 1981). The present publication reports the results of more recent surveys carried out at the Kent Group, south-western Tasmania and Bicheno. Proposals are made for marine reserves in the vicinity of the Kent Group and Governor Island. Descriptions of the boundaries of two small marine reserves (Ninepin Point and Tinderbox) which were proposed in the 1981 report are also given here. It is not now recommended that a third D'Entrecasteaux Channel marine reserve (Woodbridge) be proceeded with.

2. METHODS AND TERMINOLOGY

The methods used in this study are generally similar to those described previously (Edgar, 1981). Records of the prominent and easily identifiable species of plants, invertebrates and fish were noted underwater on a waterproof notepad. Unusual species were collected and lodged with the appropriate authorities. Quantitative benthic transects were made in the Kent Group at the moderately exposed point south of West Cove (Site 1) and in sheltered Garden Cove (Site 2). At these sites estimates were made of the percentage cover of the macro-algal species present in quadrats placed at five metre intervals along a graduated line running from low water mark perpendicular to the shoreline.

The degree of wave action at the sites discussed in this study is classified using the wave exposure scheme of Bennett and Pope (1960). Shores range in exposure from maximal, where breakers constantly strike the coast, through submaximal and moderate exposure to sheltered open coasts and sheltered bays.

Because a distinctive mid-eulittoral zone is generally lacking along Tasmanian coasts, the intertidal region is best classified into four zones (similar to Bennett and Pope, 1960,and Saenger, 1972) rather than the five of Womersley and Edmonds (1958) and King (1973). The boundaries of these zones are defined by changes in the biotic assemblages and do not necessarily coincide with physical boundaries such as low water mark (see Simpson, 1976). The uppermost zone, which is generally composed of bare rock with scattered *Littorina* spp, is termed the supralittoral fringe in this report. Descending from this level are the upper-eulittoral zone (consisting largely of barnacles and limpets), the lower eulittoral zone (often dominated by algae) and the sublittoral fringe (consisting of algae buffeted by wave surge). Sublittoral fringe algae may be absent in sheltered waters but form a prominent band along maximally and sub-maximally exposed coasts. The sublittoral environment is divided into upper (brown algal) and lower (red algal) zones.

3. THE KENT GROUP

3.1 Introduction

The Kent Group (145°20'E, 39°29'S) comprises three major islands (Deal, Dover & Erith) and two minor islands (North East and South West) which are situated in Bass Strait approximately halfway between the northern tip of Flinders Island and Wilsons Promontory (Fig. 3.1).

Few scientific expeditions were made to the Kent Group between the first visit by a naturalist, Robert Brown in 1803, and that of Bennett and Pope (1960) who incorporated intertidal data from Deal Island in a revision of south-east Australian marine provinces. However, a number of more recent visitors have recognised that the islands have interesting biogeographic affinities. King (1973) found that some marine species reach the Kent Group but do not penetrate further south and he speculated on the roles of currents and water temperatures in the distributions of these organisms. After a recent expedition Last (1979) extended these findings, noting that "the fish fauna of this exposed island group is basically Peronian and possibly constitutes the southernmost stronghold for this province".

The present report describes the results of an investigation carried out in April 1981. Observations were largely restricted to six sites in the region (Table 3.1).

3.2 The Physical Environment

3.2.1 Geology

The granitic islands of the Kent Group represent peaks of a coarse grained Devonian batholith which extends from the Victorian coast to Maria Island and Freycinet Peninsula in eastern Tasmania. The shores of the islands generally fall steeply as cliffs and submerge to sand at depths of up to 50 m.

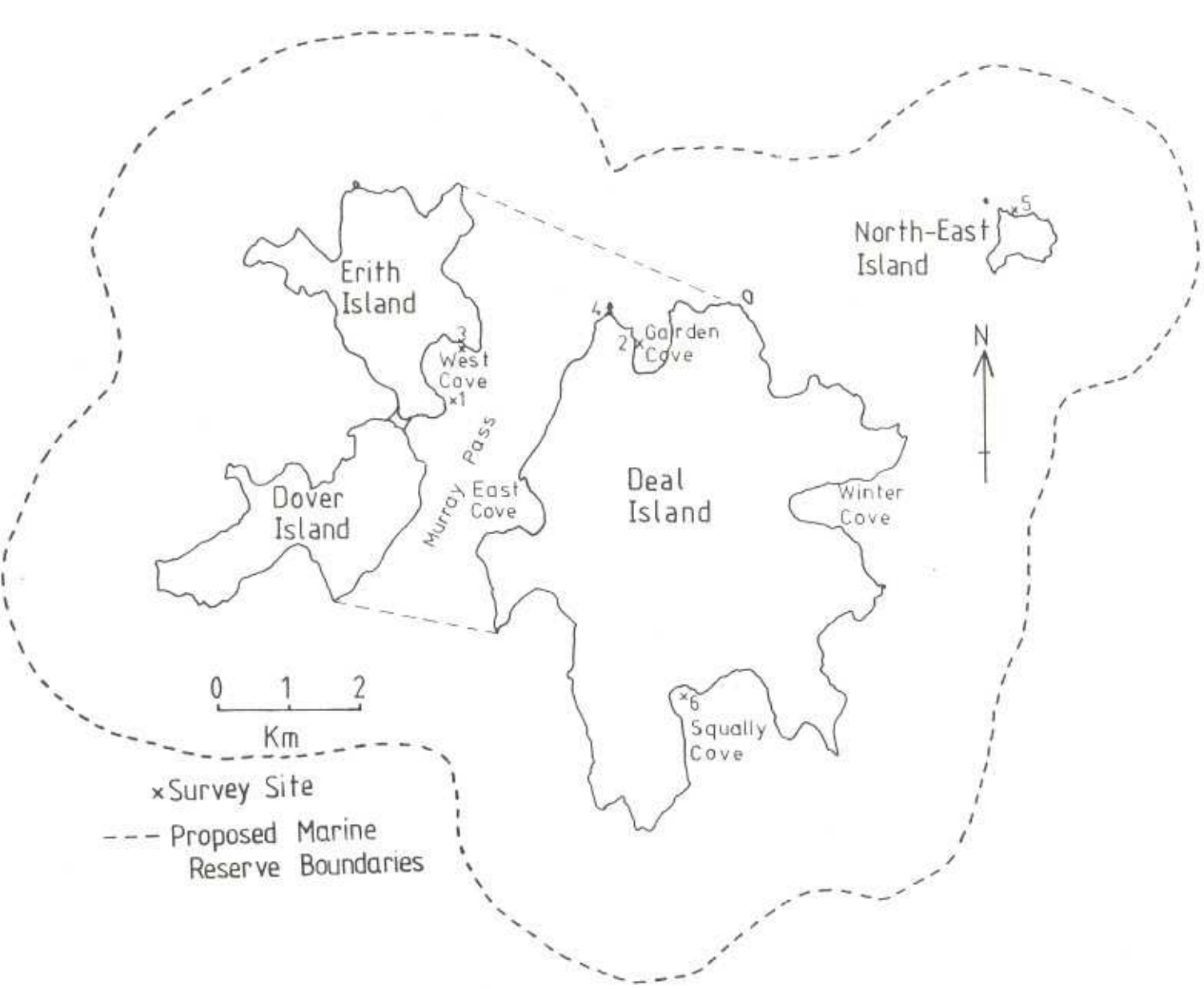


Fig 3.1 The principal islands of the Kent Group.

Table 3.1 Kent Group Site Information

Site No.	Locality	Maximum Depth (metres)	Wave Exposure	Topo
1	South-eastern point, Erith Is.	35_+	Moderate	Steeply sloping r deve
2	Garden Cove, Deal Is.	7	Sheltered Bay	Rounded boulders
3	West Cove, Deal Is.	8	Sheltered open coast	Sloping rock; cav
4	Hat Rock, Deal Is.	20+	Sub-maximal	Smooth, steeply-s
5	North East Is.	20+	Sub-maximal	Smooth, steeply-s
6	Squally Cove, Deal Is.	8+	Sheltered Bay	Broken Rock.

The underwater topography is dominated by massive granite blocks interspersed by clefts, ledges and caverns. Fields of rounded boulders approximately 1 m in diameter occur in shallow water in West Cove, Garden Cove and Squally Cove.

3.2.2 Hydrology and Meteorology

Tides are semidiurnal with a range of 2.1 metres occurring between MHHW and MLLW at Winter Cove, Deal Island (Australia National Tide Tables 1978). Permanent tidal standing waves in the vicinity of the Kent Group, and also a second set of standing waves near King Island, are considered by Pollock (1971) to restrict the movement of surface water from Bass Strait. However, a predominant eastward flow of cool waters through the Strait north-east of the Kent Group occurs during winter. This flow partly consists of deep saline water which cascades from eastern Bass Strait westwards along the Victorian coastline and is thought to influence the migrations of some fish species (Godfrey *et al*, 1980). Large eddy systems which break from the East Australian Current and move south from the New South Wales Coast (Nilsson and Cresswell, 1981) probably also irregularly influence the Kent Group.

Local currents are present throughout the region and can be particularly strong in Murray Pass.

Prevailing winds are generally from a west to south-westerly direction, and submaximal to maximal wave exposure occurs on southern and western facing coasts. Northern and eastern facing coasts are submaximally exposed, but several sheltered open bays occur around Deal and Erith Islands (Plate 3.1).

3.3 The Biological Environment

3.3.1 Submaximally and moderately exposed habitats

Benthos

A vegetation profile down to 35 metres depth at Site 1 is shown in Fig. 3.2.

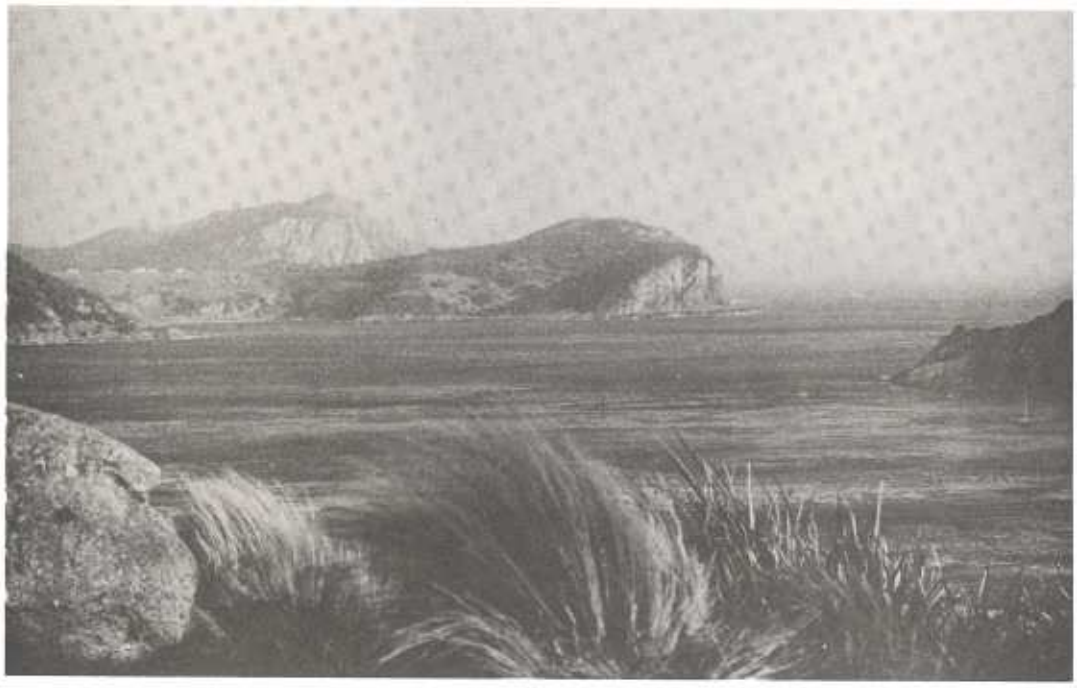


Plate 3.1 View of the southern section of Deal Island and Murray Pass from the vicinity of West Cove, Erith Island.

Plate 3.2 Macroalgae, primarily *Cystophora monilifera*, at a depth of 5 m in Garden Cove, Deal Island.

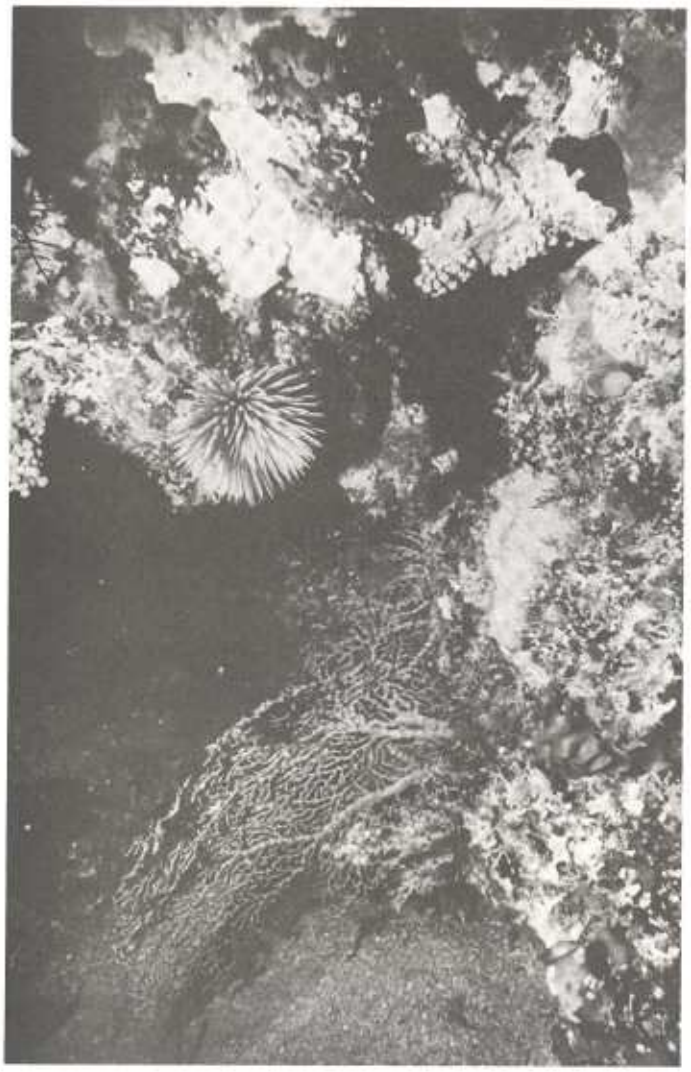


Plate 3.3 Lower sublittoral benthic faunal assemblage at a depth of 30m, Erith Is.

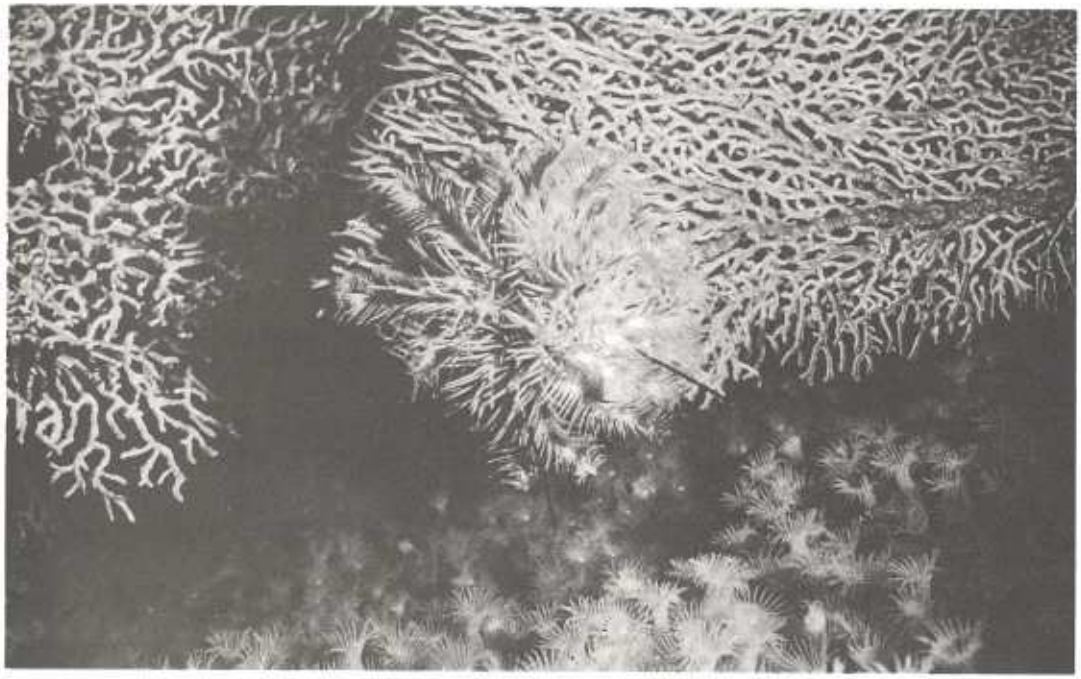


Plate 3.4 Gorgonian *(Mopsea zimmeri)*, feather star *(Ptilometra australis)* and yellow zoanthids at a depth of 6 m at Erith Island.

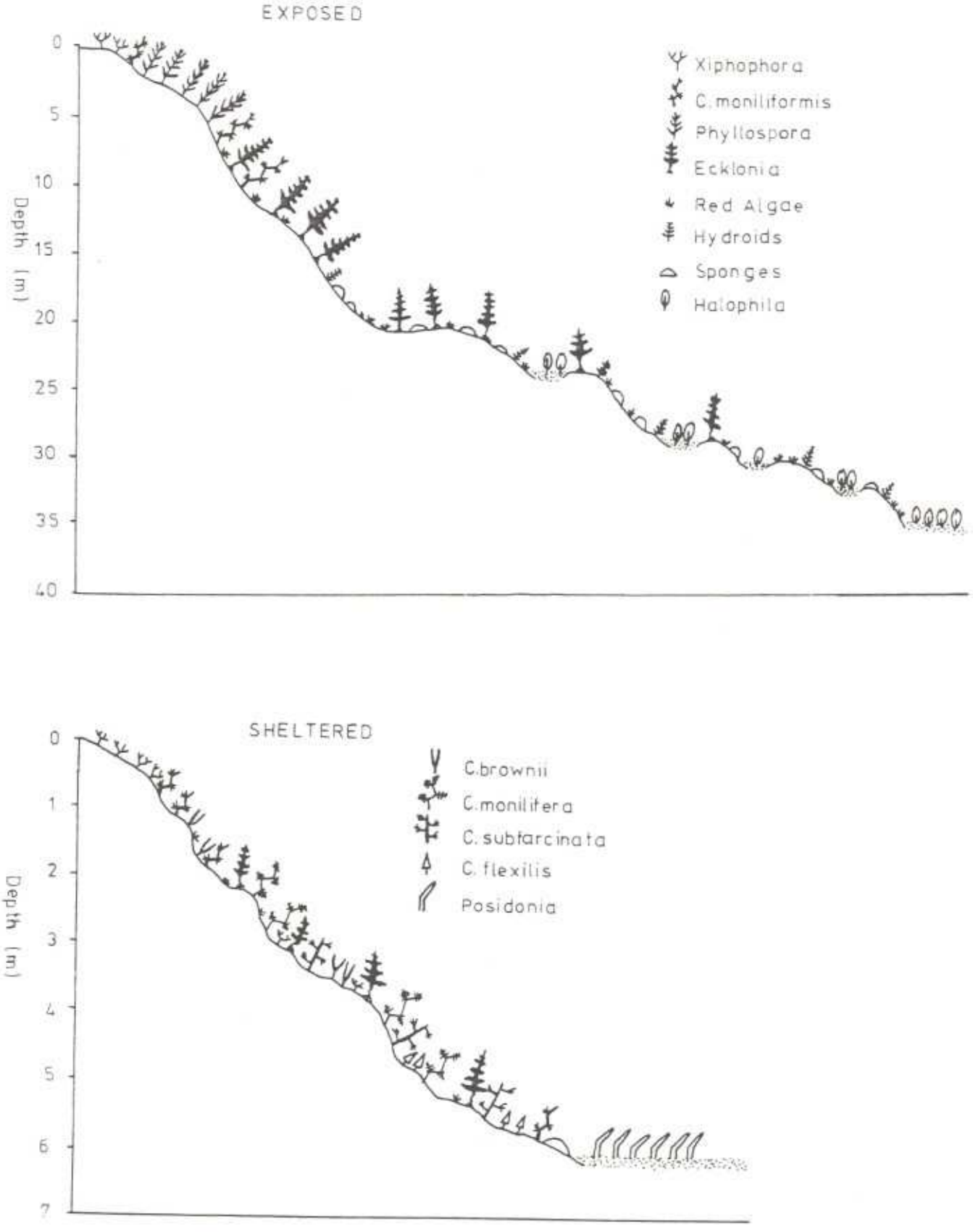


Fig 3.2 Vegetation profiles at exposed (Site 1) and sheltered (Site 2) localities in the Kent Group.

The barnacles *Chthamalus antennatus* and *Chamaesipho columna*, the alga *Sphlachnidium rugosum* and the limpets *Siphonaria diemenensis* and *Cellana solida* are the prominent benthic organisms in the upper eulittoral zone.

Megabalanus nigrescens occurs at the highest levels of the lower eulittoral zone. This zone is characterised throughout by a band of *Corallina officinalis*. The chiton *Poneroplax costata* and *Cellana solida* are the most common animals. *Codium pomoides* and a few stunted *Cystophora torulosa* are present in the lower regions.

The sublittoral fringe comprises bands of *Xiphophora chondrophylla* followed by *Gelidium australis* and *Cystophora moniliformis*, and extends to about two metres depth. Dense monospecific *Phyllospora comosa* stands form a very abrupt zonation level below the *C. moniliformis*. *Phyllospora* appears to be a competitive dominant in rough, shallow water because *C. moniliformis* and *Xiphophora* also occur below the *Phyllospora* level. *Phyllospora* merges with a more diverse algal community at depths ranging from 10 metres in submaximally exposed sites to 4 metres in moderately exposed sites. *Ecklonia radiata*, *Acrocarpia paniculata*, *C. moniliformis* and in some places *Caulerpa brownii* and *Macrocystis angustifolia* become co-dominant below these levels. Other algae abundant in the upper sublittoral zone are various species of *Sargassum*, *Halopteris* and *Zonaria*, together with *Phacelocarpus labillardieri*, *Plocamium dilatum*, *Plocamium angustum* and *Melanthalia obtusata*.

A lower sublittoral zone at site 1 is dominated by colonial animals and red algae and begins at 25 metres depth (Plate 3.3). The underwater topography in this zone is broken, with extensive sand patches colonised by the seagrass *Halophila ovalis* in deeper water. Algal cover is low and the available rocky substratum is overgrown by a diverse and colourful assemblage of sponges, gorgonians, alcyonarians, bryozoans and ascidians (including the very abundant *Herdmania momus*). A species of feather star, *Ptilometra australis*, not previously recorded from Tasmania was present in this zone (Plate 3.4).

Fish

Fish species recorded from the various sites surveyed around the Kent Group are listed in Appendix 1. Almost all of the prominent fish species occurring in shallow water at exposed localities are also commonly found on the northern east coast of Tasmania and throughout Bass Strait. These species include purple wrasse *(Pseudolabrus fucicola)*, blue-throated wrasse *(Pseudolabrus tetricus)*, sea carp *(Dactylosargus arctidens)*, senator fish *(Pictilabrus laticlavius)*, long-finned pike *(Dinolestes lewini)*, herring cale *(Olisthops cyanomelas)*, zebra fish *(Melambaphes zebra)*, toothbrush leatherjacket *(Penicipelta vittiger)*, bastard trumpeter *(Latridopsis forsteri)*, sweep *(Scorpis lineolatus)*, sea sweep *(Scorpis aequipinnis)*, trachinops *(Trachinops caudimaculatus)* and porcupine fish *(Diodon nichthemerus)*. Banded morwong *(Cheilodactylus spectabile)* and magpie perch *(Cheilodactylus nigripes)* are also frequently seen. The former species is abundant on the Tasmanian east coast but is less common in Bass Strait, while the latter species has the opposite distribution. White ears *(Parma microlepis)* are also abundant. This species is extremely common in New South Wales but becomes comparatively rare south of Gabo Island.

Two species found in deeper water during the survey are notable. The half-banded sea perch *(Ellerkeldia maccullochi)* and maori wrasse *(Ophthalmolepis cyanogramma)* are listed in a recent paper on the Kent Group by Kuiter (1981) but had not been previously recorded from Tasmania. Both species are very common in New South Wales. The half-banded sea perch has recently been found off north-eastern Tasmania, however the maori wrasse is yet to be found elsewhere in the State. Other species frequently sighted below 15 m (butterfly perch, *Caesioperca lepidoptera*; barber perch, *Caesioperca rasor*; and rosy wrasse, *Pseudolabrus psittaculus)* are widely distributed around Tasmania.

3.3.2 Sheltered Habitats

Benthos

Fig. 3.2 depicts a depth profile of the benthic organisms present in Garden Cove at Site 2.

Chthamalus antennatus is not as common in the upper eulittoral zone of sheltered habitats as in more exposed locations. *Chamaesipho columna, Splachnidium rugosum, Siphonaria diemenensis, Cellana solida* and *Galeolaria caespitosa* are abundant, and *Nerita melanotragus* and *Tetraclitella purpurascens* are present but confined to crevices.

The lower eulittoral zone is again characterised by a band of *Corallina officinalis*. *Hormosira* is present at the top of the lower eulittoral zone while *Cystophora torulosa* forms clumps at the lowest level.

The sublittoral fringe is not distinct but merges with the upper sublittoral zone. *Phyllospora* is absent from sheltered bays but is present to a depth of two metres in slightly more exposed areas. The dominant algae are *Ecklonia radiata, Cystophora monilifera, C. subfarcinata, C. moniliformis* and *Xiphophora chondrophylla* (Plate 3.2). These algae are all present at the maximum depths to which the rock substratum extends, however at none of the sheltered localities surveyed did this maximum depth exceed 10 m. Other species commonly found in sheltered areas were *Caulerpa simpliciuscula, C. brownii, C. flexilis, C. geminata, C. obscura, Codium harveyana, Phacelocarpus labillardieri, Zonaria* spp., *Plocamium* spp. and *Dictyota* sp. Animals are also a very conspicuous component of the sheltered benthic assemblage. The echinoids *Heliocidaris erythrogramma* and *Centrostephanus rodgersii*, the holothurian *Stichopus mollis*, the asteroids *Petricia vernicina, Tosia australis* and *Patiriella gunni*, and the shrimp *Rhyncocinetes rugulosus* are abundant, particularly in areas with broken topography.

No lower sublittoral zone was present at sheltered sites.

Shallow sedimentary substrata in Murray Pass and in the bays around Deal Island are colonised by *Posidonia australis*. Below 20 metres *Posidonia* blades are sparsely distributed. Some small colonies of another seagrass, *Amphibolis antarctica*, were observed in West Cove.

Fish

A very diverse assemblage of fish is present in sheltered rocky reef habitats. Most species common in exposed areas are also abundant in sheltered habitats (purple wrasse, blue-throated wrasse, senator fish, magpie perch, trachinops, barber perch, butterfly perch, herring cale, sweep, sea sweep, white ear, trumpeter, zebra fish long-finned pike, porcupine fish and maori wrasse). The common fish not often found outside sheltered habitats were silverbelly *(Parequula melbournensis)*, red rock cod *(Ruboralga ergastulorum)*, scalyfin *(Parma victoriae)*, mado *(Atypichthys strigatus)*, one-spot pullers *(Chromis hypsilepis)*, old wife *(Enoplosus armatus)* and Castelnau's wrasse *(Dotalabrus aurantiacus)*. Slender roughys *(Optivus elongatus)* had not been previously recorded south of New South Wales but were observed on a night dive in West Cove.

The Kent Group ichthyofauna differs considerably from that found at other Tasmanian localities during the 1980 marine reserves survey, but has greatest similarity with the Flinders Island fauna. Six species sighted at the Kent Group (viz. one-spot puller, maori wrasse, slender roughy, trevalla *(Seriolella* sp.*)*, rusty catshark *(Parascyllium ferrugineum)* and blue sprat *(Spratelloides robustus))* were not recorded during the previous survey.

3.3.3 Discussion

The Kent Group is situated at the convergence of the three southern Australian marine biogeographic provinces (Peronian, Maugean and Flindersian) and has a much greater Peronian (New South Wales) component than other Tasmanian localities (Last, 1979; Kuiter, 1981). This is probably due to planktonic larvae being carried in the warmer water moving south from New South Wales under the influence of the East Australian Current. Three species of fish recorded from the Kent Group have not been found further south (Bank's shovelnose ray, *Aptychotrema rostrata;* one-spot puller, *Chromis hypsilepis;* maori wrasse, *Ophthalmolepis cyanogramma)*. A further seven Kent Group species are rarely recorded from Tasmania but are much more common off the Australian mainland (viz. spotted stingaree, *Urolophus gigas;* sergeant baker, *Latropiscus purpurissatus;* Wilson's weedfish, *Heteroclinus*

wilsoni; mosaic leatherjacket, *Eubalichthys mosaicus*; rough leatherjacket, *Scobinichthys granulatus*; slender roughy, *Optivus elongatus*; snake-skin wrasse, *Eupetrichthys angustipes)*. The similarity between the southern New South Wales and Kent Group faunas is particularly obvious in the boulder-stewn areas of Murray Pass where the pomacentrid fishes *Parma microlepis* and *Chromis hypsilepis* are sufficiently abundant to completely subdivide the habitat into territories. Invertebrates typical of New South Wales are also common (e.g. the sea urchin *Centrostephanus rodgersii* is present in very high densities in Murray Pass).

A Maugean (southern Tasmanian) component in the marine fauna is indicated by the presence of banded morwong, bastard trumpeter, purple wrasse and velvet leatherjacket *(Eubalichthys gunnii)*. The brown-striped leatherjacket *(Meuschenia australis)* was recorded by Last (1979) and Kuiter (1981) but is relatively rare in the Kent Group and was not sighted during the present survey.

Several species of Flindersian (southern Australian) fish are present (e.g. magpie perch, sea sweep, scalyfin), however the Flindersian component in the marine biota is better shown by the flora. The dominant sublittoral algae in sheltered habitats *(Cystophora monilifera, C. moniliformus, C. subfarcinata, Acrocarpia paniculata, Ecklonia radiata* and *Sargassum verruculosum)* are similar to those found as far as Pearson Island in the Great Australian Bight (Shepherd and Womersley, 1971). The dominant algae in exposed habitats showed a closer similarity to the flora off southern New South Wales and Victoria. Three common eastern Tasmanian species *(Macrocystis pyrifera, Durvillaea potatorum* and *Xiphophora gladiata)* were not present.

The only region which would be expected to show close biotic affinities with the Kent Group is Wilsons Promontory, Victoria. Kuiter (pers. comm.), however, considers that the east side (of Wilsons Promontory) is heavily influenced by the large estuaries further north and is very silty, and is consequently quite different to the Kent Group. The marine ecosystems on the western Wilsons Promontory coast, on the other hand, show some similarities with the Kent Group as white ear, one-spot pullers and maori wrasse have been recorded by Kuiter (pers. comm). Nevertheless, the fish fauna present in the vicinity of Tidal River, Wilsons Promontory in July 1981, showed

a greater ichthyological similarity to Three Hummock Island than to the Kent Group (Edgar, 1984). Other island groups in Bass Strait north of Flinders Island (the Hogan and Curtis Groups) lack sheltered habitats but would be expected to have exposed ecosystems similar to the Kent Group.

A consequence of the overlapping of marine provinces in the region of the Kent Group is a high faunal diversity.

A total of 92 marine fish species were recorded in the present study and by Kuiter (1981) and Last (1979) in 15 days diving (Appendix 1). This compares with 90 species recorded during the 1980 survey from around Tasmania in over 60 diving days. Bryozoa are the only group of invertebrates intensively collected from the Kent Group. Le Souef (1891) found a high diversity with over seventy species recorded.

The number of seaweed species is also considerable, but not recognisably greater than elsewhere in the rich Bass Strait area. Womersley (1959) found that 82% of all southern Australian algae were present in the eastern (Bass Strait) region.

3.4 Marine Reserve Recommendations

In view of the scientifically interesting and diverse nature of the subtidal environment around the Kent Group, it is recommended that this habitat should be preserved as part of an integrated series of Tasmanian marine reserves.

Apart from the unique zoogeographical location, there are several other factors which reinforce the selection of the Kent Group as a marine park site.

(i) The underwater habitats are very attractive to divers because of the varied flora and fauna.

(ii) Water clarity is often exceptional as the island group is far from any major source of runoff or pollution.

(iii) Adequate protection could be afforded to the wreck of the "S.S. Bulli". This collier is still relatively intact, and, as the hull lies on sand in West Cove at only 10 metres depth, it provides

the most fascinating of the safe wreck dives in Tasmanian waters. Articles such as portholes are still being removed from this wreck. Another wreck, the "S.S. Karitane", is present in Squally Cove in shallow water but has broken apart and is less interesting to the recreational diver. This ship carried a large cargo of copper ingots, and illegal salvage operations are being undertaken to the present day. Remnants of explosives were observed strewn over the seafloor during the survey.

(iv) The Kent Group attracts visitors who would make use of a marine reserve, particularly over the summer months. Only visitors who appreciate the natural environment would be expected to arrange transport to the islands. Despite the difficulties of access, considerable numbers of Victorian divers travel to the islands by chartered boat. Holiday makers (including naturalists) are also present on Erith Island from December to March, and yachts call throughout the year.

(v) Very little non-commercial fishing is carried out in this region. Deal Island lighthouse staff catch some fish, and handlining, graball netting and spearfishing are undertaken in a minor way by the occasional visitor.

(vi) Commonwealth lighthouse staff are in a good position to police a Kent Group marine reserve and could be issued honorary warrants to enforce the National Parks and Wildlife Act and the Sea Fisheries Act.

(vii) Abalone capture by professional Tasmanian divers is minimal. The total time spent by divers in the Kent Group would rarely amount to five days per year.

Several disadvantages to the creation of a marine reserve at the Kent Group should also be taken into consideration.

(i) Access to the region is difficult. Travel to the islands can also be hazardous because weather changes in Bass Strait can occur quickly and are difficult to predict. Strong currents in Murray Pass are also a potential source of danger to the inexperienced or unprepared diver.

(ii) No facilities are available for visitors. The public presently does not have free access to the major islands, however proposals for the creation of Nature Reserves at Erith Island and Dover Island (as well as North East Island and South West Island) have recently been put forward.

(iii) Commercial rock lobster and shark fishing are carried out in the region. The rock lobster catch from north-western Flinders Island and the Kent Group represented 3.2% of the total Tasmanian catch in 1977 and 1978 (Tasmanian Fisheries Development Authority statistics). Hence, any marine reserve declared in this area would need to be designed to minimise impact on professional fishermen.

Marine Reserve Proposal

It is recommended that the boundaries of the proposed Kent Group Nature Reserve be extended to encompass the land covered by water within two kilometres of low water mark of Erith Island, Dover Island, Deal Island and North East Island (Fig. 3.1). It is also recommended that spearfishing and gillnetting be prohibited within the marine extension to the Nature Reserve, and that all types of fishing, other than angling, be prohibited within the waters of Murray Pass (as defined by the boundaries shown in Fig. 3.1).

The above proposal would protect inshore marine habitats in the vicinity of the Kent Group, with maximum protection afforded to the biogeographically unique communities of plants and animals in Murray Pass, and would not directly interfere with the activities of professional fishermen working in the area. Rock lobster and abalone fishermen should not be inconvenienced because negligible numbers of rock lobster or abalone are taken from Murray Pass. Furthermore, shark fishermen generally do not set nets within the boundaries of the proposed reserve but work waters further offshore.

In conclusion it should be noted that the creation of a successful management plan for the area will need the co-operation of a large number of interested parties who include the Commonwealth Government, National Parks and Wildlife Service, Tasmanian Fisheries Development Authority, Professional Fishermens Association and the current Erith Island grazing lessees. Consultations between intereste parties would need to concern not only the marine reserve proposal but also such associated topics as the issue of honorary National Parks and Wildlife and Sea Fisheries warrants to the Deal Island lighthouse keepers, the provision of permanent boat moorings in East Cove and/or West Cove, and the reservation of suitable foreshore for camping.

4. SOUTH WEST TASMANIA

4.1 Introduction

The marine life of the southern and western Tasmanian coasts is less well-known than that of any other comparable area of southern Australia because access between Macquarie Harbour (on the mid-west coast) and Recherche Bay (on the south-east coast) is not possible by wheeled vehicle.

Only two marine ecological studies have been reported from south-western Tasmania; an intertidal study (Bennett and Pope, 1960) and an investigation of deep water (greater than 91 metres) demersal fish assemblages (Last and Harris, 1981). Unfortunately, data collected by Bennett and Pope at their only South West site (Maatsuyker Island) have been amalgamated with other locality data in a general study of Tasmanian zonation patterns. Hence, with the exceptions of the few organisms referred to specifically in the text, the species present at Maatsuyker Island cannot be deduced from that paper.

No account of the shallow-water flora or fauna of south-western Tasmania can be found in the literature, despite a number of scientific expeditions which sampled in Tasmanian waters in the latter part of the last century and in the early part of the present century, including at least one cruise by the "F.I.S. Endeavour" along the southern and western coastlines (Dannevig, 1914). This absence of sublittoral studies has created difficulties in both determining the resources of South West Tasmania (Waterman, 1981) and discussing general features of the Tasmanian marine biota (Dartnall, 1974; Edgar, 1981).

The present study was initiated with the primary aims of reporting on the south-west Tasmanian marine biota and also of assessing the potential for any marine parks within the region. The area of study extended from Low Rocky Point to South East Cape (including the offshore islands) and encompassed the coast of the Southwest National Park (Fig. 4.1).

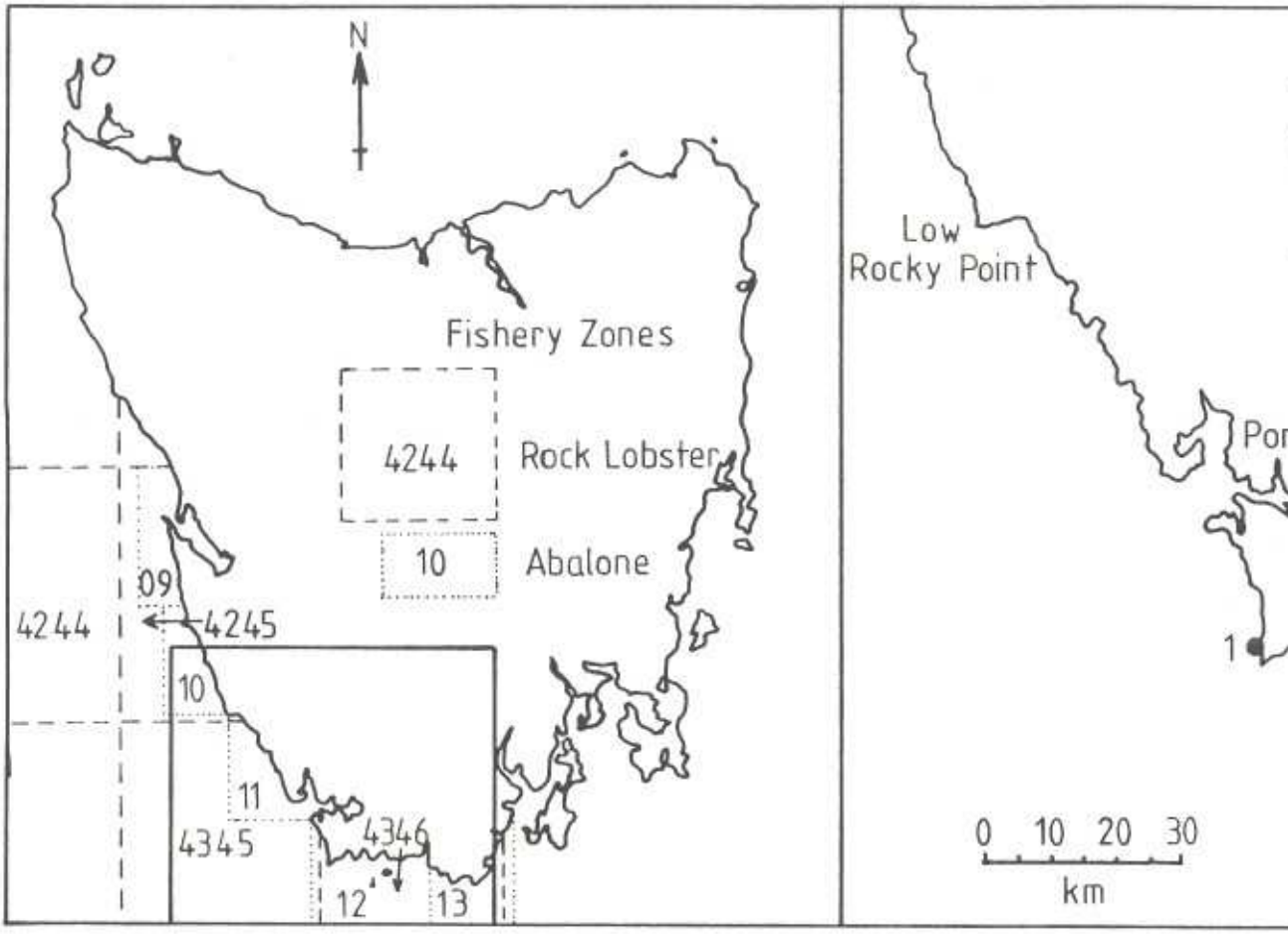


Fig 4.1 The area of study in south-western Tasmania. Sites discussed in detail

Two major regions can be delineated within the study area : the open coast which extends in a westerly direction from South East Cape to South West Cape and then in a north-westerly direction to Low Rocky Point, and the Port Davey embayment with associated Bathurst Harbour and Bathurst Channel. The Port Davey area is particularly interesting, and was considered by Thomson (1978a) to be unique, because it is the only harbour in southern Australia where marine and estuarine systems, and surrounding freshwater catchment areas, have not been greatly disturbed by man. Port Davey also differs from other Australian drowned river valleys in receiving acidic waters darkly stained by tannic acid. For these reasons the biology of the Port Davey-Bathurst Channel region has been discussed separately from that of the open coast.

4.2 The Physical Environment

4.2.1 Geology

The geomorphology and geology of the South West coast are shown in a detailed series of maps produced as part of the South West Tasmania Resources Survey (Waterman, 1981). Steep cliffs (often with associated rock platforms) are the major geomorphological feature; sandy beaches only occur along c. 20% of the coastline.

The predominant rock type in the South West is Precambrian quartzite, however other geological formations also outcrop in many places along the coast. Notable among these strata are the Cambrian granite and volcanics occurring in the Low Rocky Point region, the Devonian granite outcropping at South West Cape, the Jurassic dolerite found at South East Cape, and the Triassic siltstones and sandstones which are present along the shore of South Cape Bay.

4.2.2 Weather

Long term meteorological information is available only from Maatsuyker Island within the study area. However, Bosworth (1977) considered that this station is not completely representative of the South West region because of a tendency for winds to flow south-east around mountain ranges to the north of the Maatsuyker Group. Some shorter term meteorological records (1946-present) have also been collected at Melaleuca Inlet near Port Davey.

Monthly air temperature and rainfall information for Maatsuyker Island and Melaleuca Inlet are given in Table 4.1, and mean wind speeds and directions at Maatsuyker Island are listed in Table 4.2. These data were obtained from Bosworth (1977).

Temperatures show relatively little diurnal and seasonal variability (ranges of approximately $6^{o}C$ and $7^{o}C$ respectively). Temperature parameters at Melaleuca Inlet undergo slightly larger fluctuations than those at Maatsuyker Island because of the greater distance from the sea.

Rainfall along the south-west Tasmanian coast is relatively high and constant, with rain falling on the majority of days. The regular passage of high pressure systems across southern Australia in winter results in almost twice as much rain falling in the winter as in the summer months. The presence of these anticyclones also accounts for strong prevailing westerly winds at this time. These winds are recorded from a predominantly north-westerly direction at Maatsuyker Island because of the presence of mountain ranges near the south coast.

4.2.3 Ocean Swell

The available data on the sea-state of South West Tasmania have been collated and discussed in a paper by Matthews (1978).

Swell roses recorded at Maatsuyker Island (Fig. 4.2) indicate that heavy seas (a swell height exceeding 2 metres) predominate in all months of the year but are most common and most intense from April to September. Along the southern coast the swell direction is almost exclusively from the south-west, however data collected at Cape Sorell (Matthews, 1978) indicates that westerly swells are equally important on the west coast.

4.2.4 Tides

Tidal characteristics have been recorded for only two sites in the region, Bramble Cove (Port Davey) and Maatsuyker Island (Table 4.3).

Tides along the South West coast are microtidal and occur almost simultaneously because of the narrow continental shelf. They are of a

Table 4.1. Mean maximum and minimum daily temperatures (°C), and mean monthly rainfall (mm), at number of rain days per month is also given for Maatsuyker Island.

Maatsuyker Island (1891 - 1975)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	
Maximum Temp.	17.5	17.6	16.5	14.7	12.5	11.6	10.9	11.3	12.2	13.5	14
Minimum Temp.	10.6	11.1	10.5	9.5	8.0	7.1	6.3	6.3	6.6	7.3	8
Rainfall	77	68	85	109	114	116	125	117	105	104	
No. of Rain Days	17	15	18	21	23	22	24	24	23	23	

Melaleuca Inlet (1946-1970)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	
Maximum Temp.	19.1	19.4	18.1	15.8	13.3	12.3	12.0	12.6	14.4	15.7	1
Minimum Temp.	9.1	10.1	8.8	7.8	6.6	5.1	4.8	4.8	5.4	6.1	
Rainfall	133	164	163	221	244	223	261	292	271	205	17

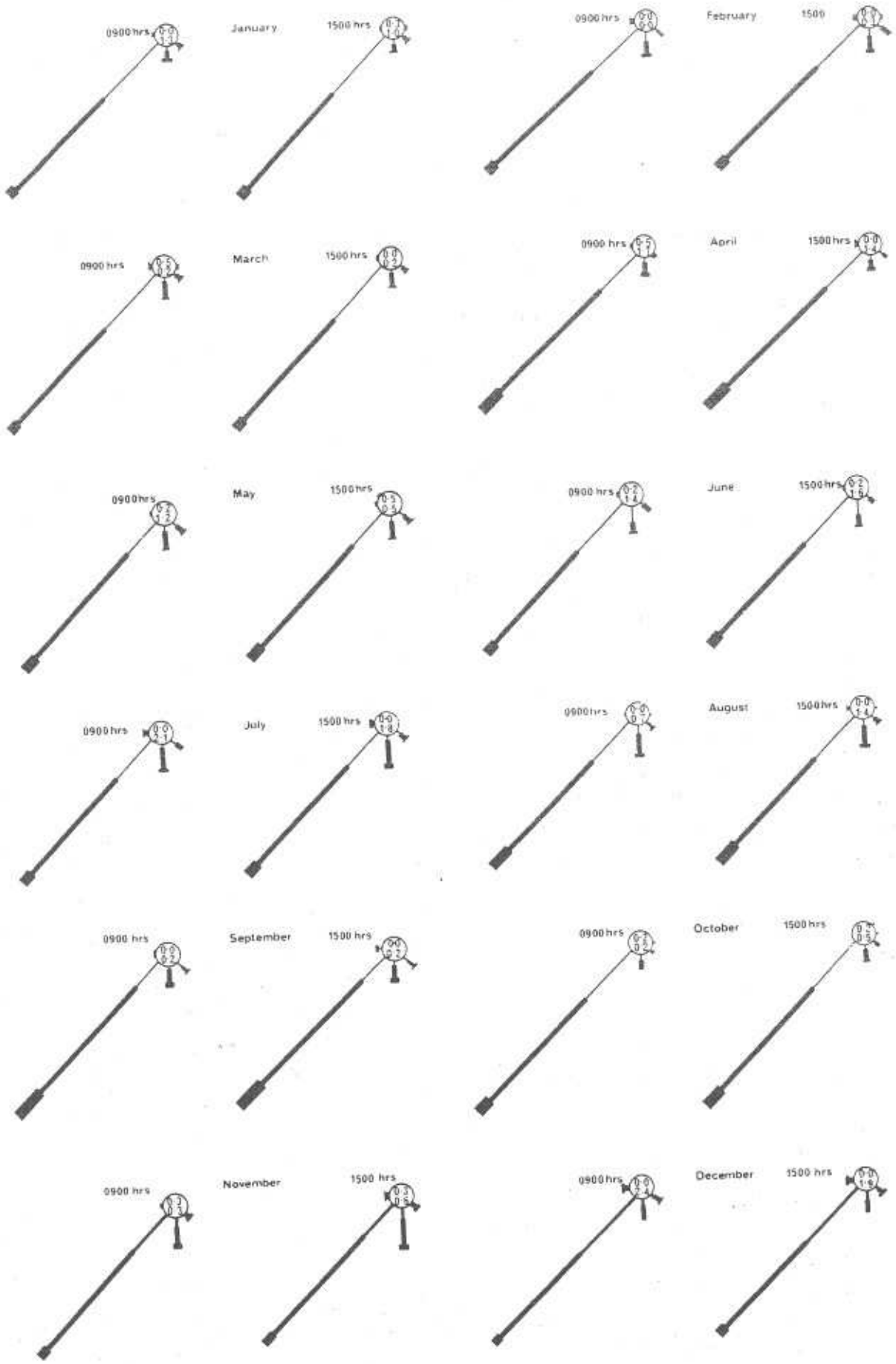


Fig 4.2 Swell roses - Mattsuyker Island (from Matthews, 1978).

mixed type with small diurnal to semi-diurnal ratios and a minor semi-diurnal solar component. Matthews (1978) considered that meteorological influences on the sea level may be at least as important as the lunar and solar influences, particularly over the winter months. Storm surge probably causes changes in water level in excess of 0.5 metres in enclosed bays such as Port Davey.

Table 4.3 Tidal characterstics at Bramble Cove and Maatsuyker Island (after Matthews, 1978).

Location	Mean Semi-diurnal Spring Range (m)	Mean Diurnal Spring Range (m)	Tidal Range (m)	Tidal Type
Bramble Cove	0.39	0.63	1.02	Mixed
Mattsuyker Is.	0.26	0.65	0.91	Diurnal

4.2.5 Hydrology

Open Coast

Seasonal variations in the temperature, salinity and nutrient content of southern and western Tasmanian coastal waters are very poorly known. Ten year average surface temperature and salinity fields (from 1967-1976) indicate that temperatures along the southern coast range from c. 17°C in February to c. 12°C in August with salinities approximately constant at 35.1‰ (Edwards, 1979). This hydrological information is approximate because it is based primarily on extrapolation from Tasmanian east coast data. Sea-surface temperature charts provided by Bosworth (1977) (a range from c. 15°C in January to c. 11°C in October) presumably also contain inherent errors because of the lack of field data and poor resolution of temperature contours.

Southern Tasmanian waters are believed to be relatively productive due to high levels of nitrates (c. 1.0 µg at $NO_3N/1$) and phosphates (> 0.2 µg at. $PO_4P/1$) (Rochford, 1979). These high nutrient concentrations are associated with the subantarctic water mass which is the major water body off eastern, southern and western coasts in

winter, but contracts to the south-east in summer (Rochford, 1974). The movement of the antarctic water mass suggests that south eastward flowing currents operate in winter, followed by a clockwise flow of water around south-western Tasmania in summer. The movement of drift bottles released off the west coast (Newell, 1960) reinforces this hypothesis: bottles released in summer travelled in a north-westerly direction while those released in winter were transported by currents southward down the west coast and then eastward along the southern coast. Slightly conflicting conclusions were reached in a recent study by Baines *et al.* (1983) where a north-west Tasmanian current was found to vary seasonally in strength but to flow southward throughout the year.

Port Davey

Thomson (1978a,b) presents hydrological data collected in summer 1977/78 and winter 1978 at a number of sites within the Port Davey/Bathurst Harbour region. Surface water temperatures were generally warmer than those at depth over the summer months but the thermocline was overturned during winter. For example, at Bramble Cove temperatures of 9.3°C at the surface and 11.0°C at 3 metres depth were recorded in July, 1978, while in December 1977 the corresponding temperatures were 17.0°C and 15.5°C. The annual and diurnal ranges in water temperatures were much greater for shallow water bodies, such as Kelly Basin and Melaleuca Inlet, than the deeper areas of Port Davey and Bathurst Channel. On one occasion the surface temperature in Melaleuca Creek fell from 22.0°C to 14.8°C overnight after a cool change passed through the area.

A striking feature of the hydrology of the Port Davey region is the presence of a well-defined brackish water layer in Bathurst Harbour and Bathurst Channel. This brown, tannin-rich water layer greatly reduces light penetration to the depths below the halocline. An influx of freshwater during the winter period of maximal rainfall caused the width of the brackish water layer, as recorded by Thomson (1978a,b), to vary from about 2 metres in summer to between 3 and 4 metres in winter. There was little evidence for a geographical change in the depth of the halocline from Bathurst Harbour to the western entrance of Bathurst Channel.

The discolouration of the freshwater flowing into Port Davey is not unique to that area but is a common feature of riverine and lacustrine systems in South West Tasmania. It is caused by the predominance of ancient, inert rock types and the presence of sedgeland peats which isolate water flow from rock contact (Buckney and Tyler, 1973). Local discolouration of marine waters occurs near the mouths of almost all rivers in the region.

4.3 The Biological Environment

4.3.1 Open Coast Benthos

In order to describe the general characteristics of the inshore biota of the open coast of south-western Tasmania, the eulittoral and sublittoral zonation patterns are described for a representative site on the southern shore of Shoemaker Bay 500 metres south-west of Granite Beach (Lat. 43° 46'S, Long. 140° 40'E). The benthic community at this site is later compared with those found at other areas of the South West where zonation patterns differed in some way.

Shoemaker Bay

The rock substratum at the Shoemaker Bay site slopes in a series of steps to a depth of c. 8 metres at a distance of 60 metres from the shore, and then submerges under sand. The site is sheltered from south-westerly wave action but receives considerable storm surge in southerly weather. It is moderately exposed to wave action.

The supralittoral fringe is occupied almost exclusively by the mollusc *Littorina praetermissa*, however occasional individuals of *Lepsiella vinosa* and *Cellana solida* are also found shoreward of the intertidal zone.

The upper and lower eulittoral zones are not clearly defined. Several organisms, such as the limpet *Notoacmaea mayi* and the barnacle *Catomerus polymerus*, range at intermediate tidal heights through both zones. The upper eulittoral zone is dominated by the gastropods *Cellana solida*, *Patelloida latistrigata*, *Siphonaria tasmanica*, *Siphonaria diemenensis* and *Cominella lineolatus*, the chiton *Sypharochiton*

pelliserpentis, the mussel *Brachidontes rostratus*, and the barnacle *Chamaesipho columna*. The lower eulittoral zone is characterised by the limpet *Patellanax peroni*, the chiton *Poneroplax costata*, and the algae *Lithophyllum hyperellum* and *Corallina* sp.. Rockpools within the intertidal zone possess a number of plant (*Ulva* sp., *Plocamium angustum*, *Codium fragile*, *Corallina* sp.) and animal species (the gastropods *Turbo undulatus*, *Nerita melanotragus* and *Austrocochlea constricta*, the seastars *Patiriella exigua* and *Patiriella calcar*, the crabs *Paragrapsus quadridentatus* and *Naxia aurita*, the polychaete *Galeolaria caespitosa*, and several species of anemone.

The sublittoral fringe along the shore of Shoemaker Bay is characterised by the large brown kelp *Durvillaea potatorum*, which extends to a depth of c. 3 metres. A limpet, *Patelloida victoriana*, is found abundantly on the rock substratum among the holdfasts of *Durvillaea*. A few other species of algae, such as *Cystophora xiphocarpa* and *Caulerpa brownii*, occur in the sublittoral fringe at the sheltered northern end of the shore adjacent to Granite Beach, while occasional specimens of *Xiphophora gladiata* are present amongst the bull kelp in more exposed localities.

Phyllospora comosa occurs on horizontal or oblique substrata below the *Durvillaea* band, and in slightly deeper water this species intergrades with *Cystophora xiphocarpa*, *Cystophora platylobium* and occasional small *Ecklonia radiata*. Vertical rock faces in the same area are colonised by *Caulerpa brownii* and a number of species of red algae, sponges and bryozoans (particularly *Orthoscuticella ventricosa*). *Macrocystis pyrifera* is commonly present in deeper water near the edge of the sand.

South Cape Bay

Sublittoral, benthic zonation patterns at South Cape Bay (43° 37'S, 146° 48'E) are similar to those at Shoemaker Bay, however the greater shelter at South Cape Bay, and the horizontal profile of the sandstone rock platform, allows a slightly different intertidal community to develop.

The most obvious differences are the occurrences at South Cape Bay of large, monospecific stands of *Enteromorpha intestinalis* in the supralittoral fringe and upper eulittoral zone (caused by local seepages of fresh water), and the presence of barnacles (*Catomerus polymerus* and *Chamaesipho columna*) in dense bands rather than as isolated individuals. Two algae, *Scytosiphon lomentaria* and *Gigartina ancistroclada*, are prevalent in the lower eulittoral zone but were not sighted at Shoemaker Bay. The former species is particularly common in sand scoured areas while the latter species is most abundant in marine areas where the salinity is slightly depressed by outflow from nearby creeks and rivers. Less conspicuous species which are present at South Cape Bay but could not be found at the Shoemaker Bay site are the crabs *Leptograpsus variegatus* and *Cyclograpsus granulosus*, the barnacle *Tetraclitella purpurascens*, the anomuran *Petrolistes elongatus*, the mollusc *Patelloida alticostata* and several unidentified turf algae.

South West Cape

The sublittoral zonation patterns at a site 2 km north of South West Cape (43° 33'S, 146°02'E) differed from those observed in other areas, possibly because of the steeply sloping granitic coastline which is unique to the area. Intertidal zonation patterns may also be different, however the intertidal zone was difficult to approach because of wave action, and consequently could not be properly investigated. Nevertheless, turf algae grew as a dense mat in the lower eulittoral zone while the coralline alga *Lithophyllum hyperellum* and animals other than *Poneroplax costata* appeared to be scarce.

Durvillaea potatorum extends to only 1 metre depth at South West Cape. A band of *Xiphophora gladiata* is present below this level. Between depths of 2.5 to 4 metres patches of an unidentified, possibly undescribed, species of *Xiphophora* occur. At depths from 4 metres to the greatest depth examined (25 metres)the rock substratum is relatively bare of algae but occupied by large numbers of abalone (*Haliotis ruber*). The macro-algae which are present at intermediate depths as isolated plants include *Ecklonia radiata*, *Cystophora platylobium*, *Xiphophora gladiata* and *Caulerpa brownii*, while *Lessonia corrugata*, *Ecklonia radiata*, *Caulerpa trifaria*, *Melanthalia obtusata* and *Thamnoclonium clariferum* are sparsely distributed in deeper water.

The paucity of macro-algae at South West Cape is surprising in view of the considerable wave exposure and the fact that kelps were abundant at all other exposed sites to depths exceeding 15 metres (or to the edge of sand). This reduced growth of algae is possibly a consequence of (i) the granitic substratum, and/or (ii) the high densities of abalone. The first hypothesis assumes that granite erodes subtidally more rapidly than finer grained rocks with the consequence that kelps are prevented from securely attaching to the rock substratum for the long time needed for completion of the plant's lifecycle. However, the presence of *Durvillaea* in the wave-lashed sublittoral fringe indicates that this hypothesis does not fully explain the observed patterns. Alternatively, the dense abalone population, which is not heavily exploited because of the inacessability of the region and unreliable seastate, may consume almost all algae. It should be noted, however, that abalone may be numerous as a consequence of the open space, rather than the cause of it. Field experiments are needed to deduce the reason for the lack of algae because there are important management implications (e.g. in marine reserves) if abalone harvesting is found to reduce grazing pressure and cause an increase in algal cover.

Maatsuyker Island

The intertidal and subtidal zonation patterns at DeWitt and Maatsuyker Islands follow the general trends of the adjacent mainland.

For example, near the landing jetty at Maatsuyker Island ($42^{o}39'S$, $146^{o}17'E$) the vertical distribution of organisms consists of *Littorina praetermissa* and occasional *Lepsiella vinosa* in the supralittoral fringe; *Siphonaria tasmanica, Siphonaria diemenensis, Cellana solida, Sypharochiton pelliserpentis* and *Patelloida latistrigata* in the upper eulittoral zone; *Lithophyllum hyperellum, Gigartina ancistroclada, Patellanax peroni* and *Poneroplax costata* in the lower eulittoral zone; *Cyclograpsus granulosus, Galeolaria caespitosa, Actinia tenebrosa, Anthothoe albocincta, Ulva* sp., *Naxia aurita* and *Ischnochiton subviridis* in rock pools; and *Durvillaea potatorum, Xiphophora gladiata*, *Lessonia corrugata* and *Patelloida victoriana* in the sub-

littoral fringe. The only major difference between this zonation pattern and that occurring at Shoemaker Bay is a complete lack of barnacles at Maatsuyker Island.

Durvillaea is the dominant algae along the north-eastern coast of Maatsuyker Island to depths of 7 metres where *Phyllospora comosa* and *Macrocystis pyrifera* become most prominent (to depths of about 12 metres where the bedrock submerges under sand). *Phyllospora* also occurs in patches among the *Durvillaea* at depths of 4 to 7 metres. A variety of other macro-algae are also present in depths greater than 5 metres, including *Cystophora xiphocarpa, Cystophora platylobium, Phloecaulon spectabile, Carpoglossum confluens, Sargassum* sp., *Xiphophora gladiata, Lessonia corrugata, Zonaria* sp., *Caulerpa brownii, Jeannerettia lobata* and *Melanthalia obtusata*. Three of these species *(Jeannerettia, Phloecaulon* and *Sargassum)* are rare or absent along the southern coast, but common in Recherche Bay, and are presumably present because of the unusually sheltered conditions along the leeward coast of Maatsuyker Island.

Eddystone Rock

Pedra Branca (43°52'S, 146°58'E) and associated Eddystone Rock occur as isolated Precambrian sandstone rock outcrops 25 km south of South East Cape. They comprise the southernmost islands on the Australian continental shelf and are believed to have been isolated from Australia for 18,000 years; the longest separations from the mainland of any islands in southern Australia (Rawlinson, 1974).

Only one dive was logistically possible in this region, and the intertidal zone could not be approached. However, the sublittoral zone was found to have a structure different from that elsewhere in Tasmania. At the study site, which was located on a gently sloping reef on the eastern side of Eddystone Rock, *Durvillaea* extends from well above low water mark to depths of at least 30 metres , which compares with a maximum observed depth of 10 metres in coastal waters around Tasmania (recorded at South Bruny Island). Several species of red algae (notably *Lenormandia muelleri* and two large undescribed species) occur amongst the bull kelp at depths greater than 5 metres. *Durvillaea* becomes patchy below 18 metres and is interspersed with

Lessonia corrugata, *Xiphophora gladiata*, *Phyllospora comosa*, elongate (up to 2 metres long) *Ecklonia radiata*, small *Macrocystis pyrifera*, *Melanthalia obtusata*, red algae, sponges and bryozoans.

Plants in the genus *Durvillaea* reach greatest development among the subantarctic islands and the algal community structure at Eddystone Rock appears to have a more subantarctic influence than adjacent Tasmanian areas. However, species of *Durvillaea* outside Tasmania do no extend more than a few metres below low water mark (Hay, 1979). The most likely explanation for the growth of *D. potatorum* in deep water at Eddystone Rock is that it results from a combination of physical factors. The maximal wave exposure along the gently sloping substratum (with waves moving from shallow to deep water) causes whiplash motion of individual kelp fronds which probably prevents the settlement of most algae other than *Durvillaea* on the adjacent but slightly deeper rock substratum near the plants. Clear space among *Durvillaea potatorum* fronds is usually occupied by many small *Durvillaea* sporelings. Other large algae (e.g. *Ecklonia*, *Phyllospora*, *Lessonia* and *Xiphophora*) are thus prevented from growing in shallow water and survive in the marginal low light at depth. This hypothesis postulates that the *Durvillaea* zone at Pedra Branca would be relatively shallow because of the steep dropoff, and hence a community structure different from that at Eddystone Rock would occur.

4.3.2 Open Coast Fish Community

The ichthyofauna of southern Tasmanian coastal waters is highly depauperate compared with other regions of Tasmania and Australia. Only 19 species were observed during the study of the open coast and several of these species were found at only one site (viz. *Arripis trutta*, *Meuschenia australis*, *Pseudolabrus psittaculus*, *Creocele cf. cardinalis* and two undescribed clingfish).

Seven species of fish are common on south-west Tasmanian reefs and were sighted on most of the dives (viz. *Pseudolabrus fucicola*, *Dactylosargus arctidens*, *Aracana aurita*, *Latridopsis forsteri*, *Bovichthys variegatus*, *Cheilodactylus spectabile* and *Pseudophycis barbatus*), while a further five species are locally common (*Trachinops caudimaculatus*, *Latris lineata*, *Mendesoma allporti*,

Caesioperca lepidoptera and *Dinolestes lewini*).

One of the clingfish species, the first and only specimen of which was collected from Maatsuyker Island, probably belongs to a new genus and new species of the family Gobiesocidae (B. Hutchins, pers. comm.). Another larger clingfish, which was common under rocks at Eddystone Rock, was not collected but is also possibly new to science.

4.3.3 Port Davey Benthos

The influence of darkly-stained 'buttongrass' water on marine benthic zonation patterns in the Port Davey region is considerable, and is not confined to those organisms which are osmotically stressed by coming into direct contact with water of low salinity.

The tannins in the 'buttongrass' water transmit light at the red end of the spectrum but strongly absorb blue wavelengths. Consequently, little light of any wavelength penetrates below the halocline because red light is rapidly absorbed by seawater. In Bathurst Harbour, Bathurst Channel and parts of Port Davey (particularly near the mouth of Bathurst Channel), light levels below the halocline are presumably insufficient for the photosynthetic requirements of almost all plants. Hence, slow-growing colonial animals, which are usually restricted to deeper water by competition for space, can move into vacant areas generally occupied by plants in waters as shallow as two metres.

The trend for marine animal communities to enter shallow water in areas with well-developed haloclines is illustrated by the following descriptions of benthic zonation patterns at a clinal series of sites from Bond Point to Celery Top Island (Figs. 4.3 & 4.4).

Bond Point

Bond Point differs from the open coast sites primarily by being less exposed to wave action. This greater shelter allows a number of species rarely or never seen on the open coast to survive in relatively large numbers (e.g. the brown alga *Hormosira banksii*, the molluscs *Mytilus edulis planulatus* and *Patelloida alticostata*,

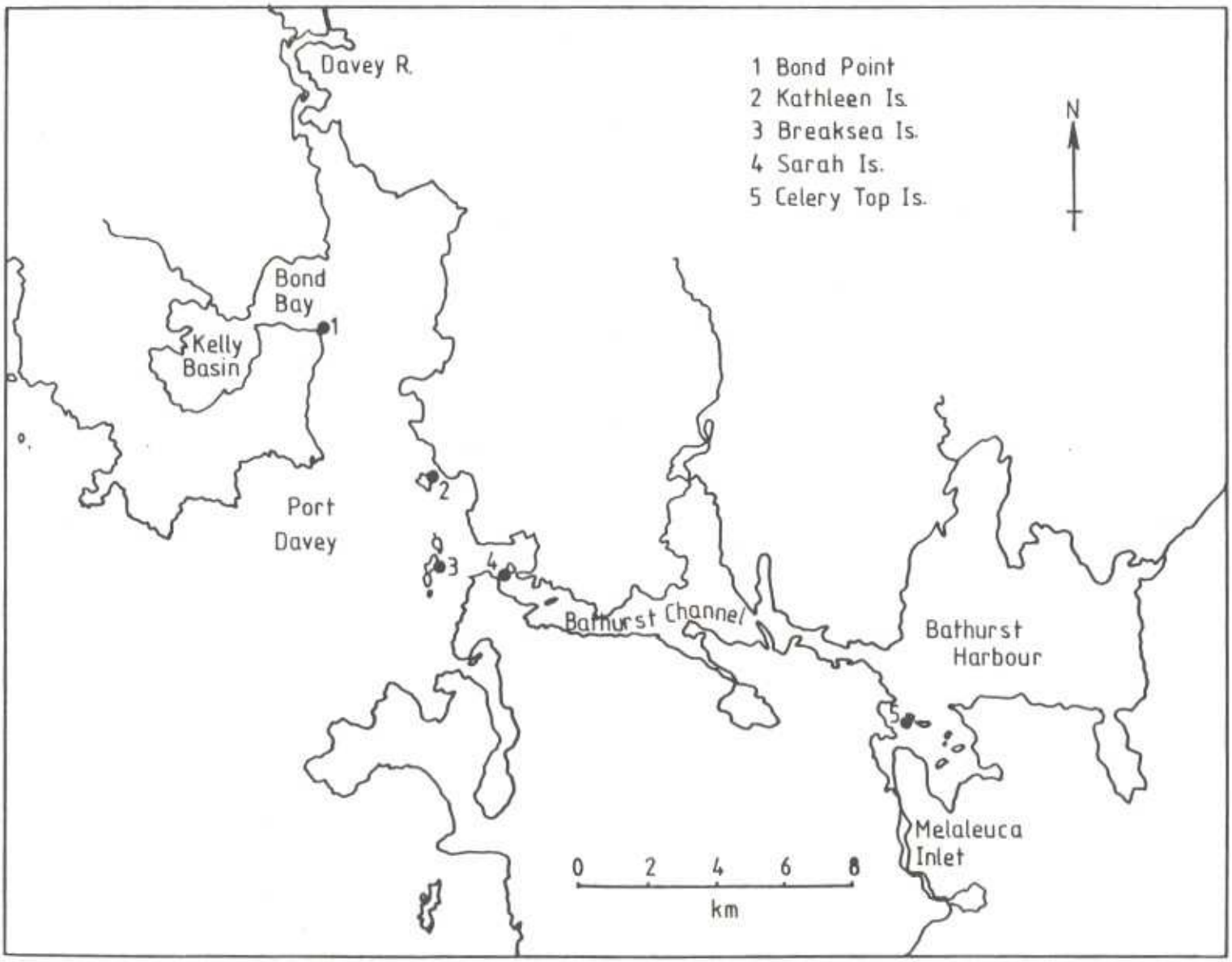


Fig 4.3 Port Davey study sites

LEGEND


Durvillaea potatorum


Ecklonia radiata


Macrocystis pyrifera


Lessonia corrugata


Xiphophora gladiata


Phyllospora comosa


Carpoglossum confluens


Cystophora platylobium


Caulerpa brownii


Caulerpa geminata


Melanthalia obtusata

Thamnoclonium clariferum


Primnoella australasiae


Sarcoptilis grandis


Capnella erecta


Gorgonian


Sonderopelta coriacea


Sponge


Codium pomoides


Echinocardium cordatum


Mytilus edulis


Xenostrobus securis


Rock


Cladophora


Sand Substrate


Ooze

LEGEND


Durvillaea potatorum


Ecklonia radiata


Macrocystis pyrifera


Lessonia corrugata


Xiphophora gladiata


Phyllospora comosa


Carpoglossum confluens


Cystophora platylobium


Caulerpa brownii


Caulerpa geminata


Melanthalia obtusata

Thamnoclonium clariferum


Primnoella australasiae


Sarcoptilis grandis


Capnella erecta


Gorgonian


Sonderopelta coriacea


Sponge


Codium pomoides


Echinocardium cordatum


Mytilus edulis


Xenostrobus securis


Rock


Cladophora


Sand Substrate


Ooze

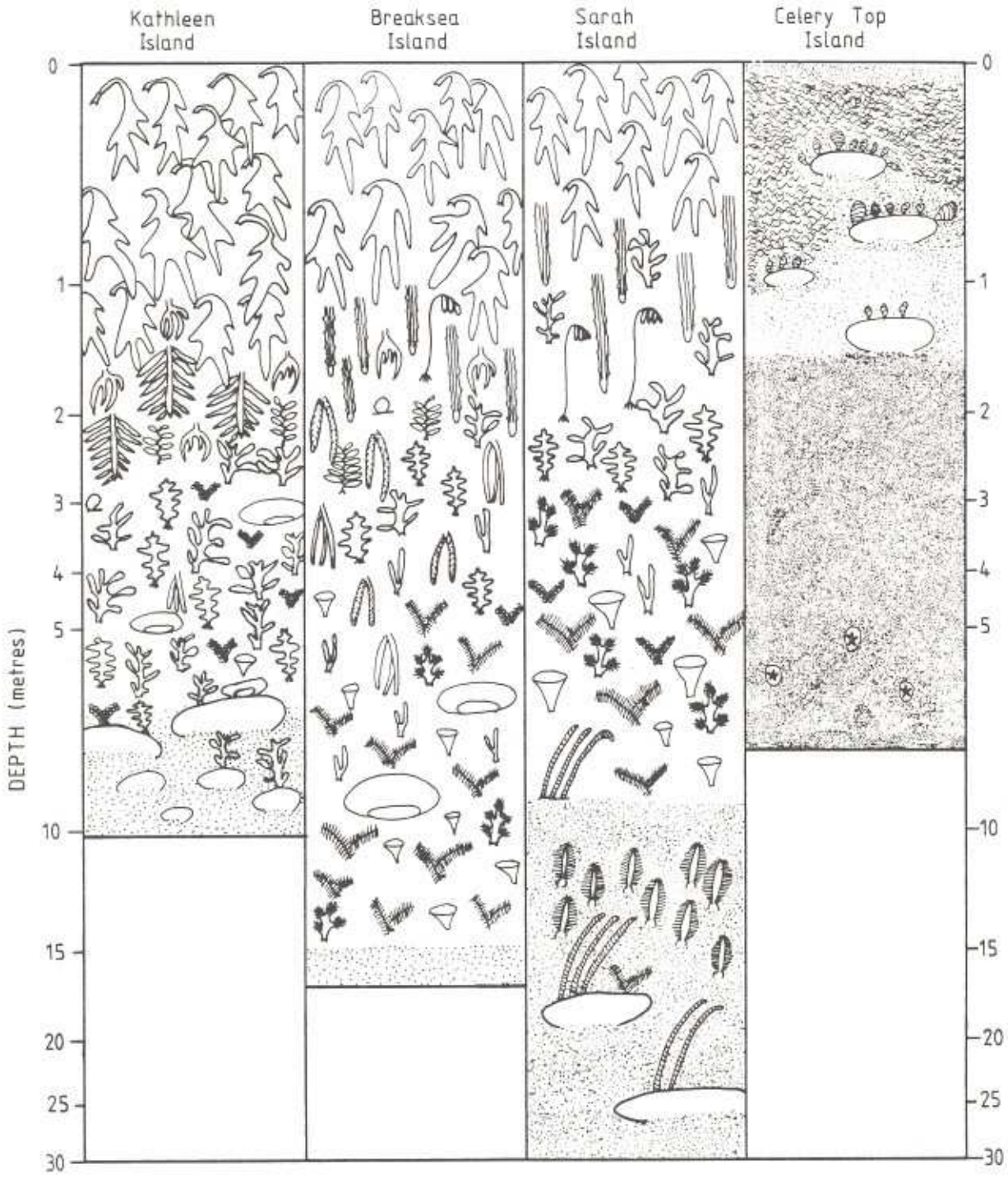


Fig 4.4 Sublittoral zonation patterns at four Port Davey sites. Legend on opposite page.

and the crab *Paragrapsus gaimardii)*. Other species which are present in the littoral zone at Bond Point and also common on the southern and western coasts are *Littorina praetermissa, Ulva* sp., *Rivularia firma, Xenostrobus pulex, Cominella lineolatus, Austrocochlea constricta, Lepsiella vinosa, Siphonaria diemenensis, Siphonaria tasmanica, Brachidontes rostratus, Sypharochiton pelliserpentis, Patelloida latistrigata, Notoacmaea mayi, Cellana solida* (rare), *Chamaesipho columna, Catomerus polymerus* (rare), *Tetraclitella purpurascens, Cyclograpsus granulosus* and *Patiriella exigua.*

Several plants typical of sheltered, sublittoral habitats but not seen along the south coast *(Cystophora moniliformis, Cystophora siliquosa, Cystophora subfarcinata* and *Sargassum verruculosum)* are abundant on reefs off Bond Point. These reefs are small in area, isolated by sand, and are confined to shallow water (< 7 metres depth). Consequently, benthic zonation patterns are not clearly defined, but follow a general trend of *Durvillaea potatorum* being dominant in shallow water, *Phyllospora comosa, Cystophora* spp., *Macrocystis pyrifera, Carpoglossum confluens, Caulerpa brownii* and *Caulerpa geminata* in intermediate depths, and *Ecklonia radiata, Thamnoclonium clariferum* and *Caulerpa trifaria* at depths greater than 5 metres. Colonial animals do not dominate the substratum at any depth.

Thomson (1978a,b) found no indication of a surface freshwater layer in Bond Bay. Surface salinities ranged from 31.4‰ in July to 32.5‰ in January.

Kathleen Island

The rocky reef at Kathleen Island slopes at a steep angle to a cobble bottom at c. 9 metres depth. The substratum at all depths is dominated by plants rather than animals (Fig. 4.4).

Durvillaea potatorum is present in shallow water (< 2 metres), followed by a mixed community of other large brown algae (viz. *Xiphophora gladiata, Phyllospora comosa, Carpoglossum confluens* and *Cystophora platylobium). Ecklonia radiata* also occurs in slightly deeper water (c. 5 metres) where red algae *(Phacelocarpus labillardieri, Melanthalia obtusata* and *Sonderopelta coriacea)* and green algae

(Caulerpa sedoides, Caulerpa trifaria and *Codium pomoides)* are also conspicuous. The broken bottom at 9 metres depth is dominated by *Caulerpa trifaria, Ecklonia, Carpoglossum* and a number of species of red algae.

The intertidal zone was not investigated at Kathleen or Breaksea Islands.

Breaksea Island

Off the western shore of Breaksea Island between depths of 6 metres and the edge of the sand at 15 metres, the benthic community is dominated by hydroids (particularly *Solanderia fusca),* gorgonians *(Mopsea whiteleggei* and *Acabaria gracillima),* sea whips *(Primnoella australasiae),* alcyonarians (particularly *Capnella erecta* and *Telesto* sp.), bryozoans and sponges (including *Phyllospongia caliciformis).* The few plant species growing within this zone are slow-growing red algae capable of surviving with little light (such as *Thamnoclonium clariferum, Melanthalia obtusata* (to depths of 8 metres) and *Sonderopelta coriacea).* A number of brown algae *(Durvillaea potatorum, Lessonia corrugata, Macrocystis pyrifera, Xiphophora gladiata, Ecklonia radiata, Carpoglossum confluens* and *Cystophora platylobium)* and green algal species *(Caulerpa brownii* and *Codium pomoides)* are present in shallow water. Surprisingly, large patches of the ascidian *Pyura stolonifera* occur at approximately 1 metres depth off the southern shore of Breaksea Island. This species is conspicuous in northern waters but not seen elswhere off south-western Tasmania.

Unfortunately, Thomson did not collect water samples at Breaksea Island, however, low-salinity water is presumably present because the surface water is very darkly stained.

Sarah Island

The substratum at Sarah Island declines steeply to depths exceeding 40 metres in Bathurst Channel. Surface salinities at nearby Hixson Point varied from 15.6‰ in winter to 22.8‰ in summer (Thomson, 1968a,b).

Sarah Island is evidently exposed to considerable wave action, particularly on the western shore, because such species as *Catomerus polymerus*, *Patellanax peroni* and *Poneroplax costata* are abundant in the lower eulittoral zone. Other species found within the intertidal zone are *Littorina praetermissa* and *Rivularia firma* in the supralittoral fringe; *Siphonaria diemenensis*, *Siphonaria tasmanica*, *Cellana solida*, *Lepsiella vinosa*, *Mytilus edulis*, *Xenostrobus pulex*, *Sypharochiton pelliserpentis*, *Chamaesipho columna* and *Gigartina ancistroclada* in the upper eulittoral zone; *Patelloida alticostata* and *Epopomella simplex* in the lower eulittoral zone; and *Austrocochlea constricta*, *Bembicium nanum*, *Ulva* sp., *Codium fragile*, *Tetraclitella purpurascens*, *Cyclograpsus granulosus*, *Paragrapsus quadridentatus*, *Lomis hirta* and *Actinia tenebrosa* in rock pools.

The upper sublittoral zone extends to a depth of 4 metres with dominant algae consisting of *Durvillaea potatorum*, *Xiphophora gladiata*, *Lessonia corrugata*, *Carpoglossum confluens*, *Ecklonia radiata* and *Macrocystis pyrifera*. At the lower end of this zone the larger brown algae give way to smaller species such as *Zonaria* sp. *Caulerpa sedoides*, *Codium pomoides*, *Thamnoclonium clariferum* and *Hemineura frondosa*.

Below 4 metres depth a colonial animal community is present. This community consists of the same species of coelenterates, bryozoans, sponges and ascidians which are found at Breaksea Island but is not as densely structured because patches of fine silt are distributed amongst the animals (Plates 4.1, 4.2). These patches of silt increase in size with depth until the reef is completely submerged under sediment at 12 metres below low water mark.

A large, spectacular colony of seapens *(Sarcoptilus grandis)* is present on the soft substratum between depths of 14 and 18 metres (Plate 4.3). Individuals (c. 25cm high) within this colony are regularly spaced apart at intervals of about 1.5 metres. The predaceous nudibranch *Armina* sp is associated with the seapens.

Plate 4.1 Sponges *(Phyllospongia caliciformis)* at depth of 12 m, Sarah Island.

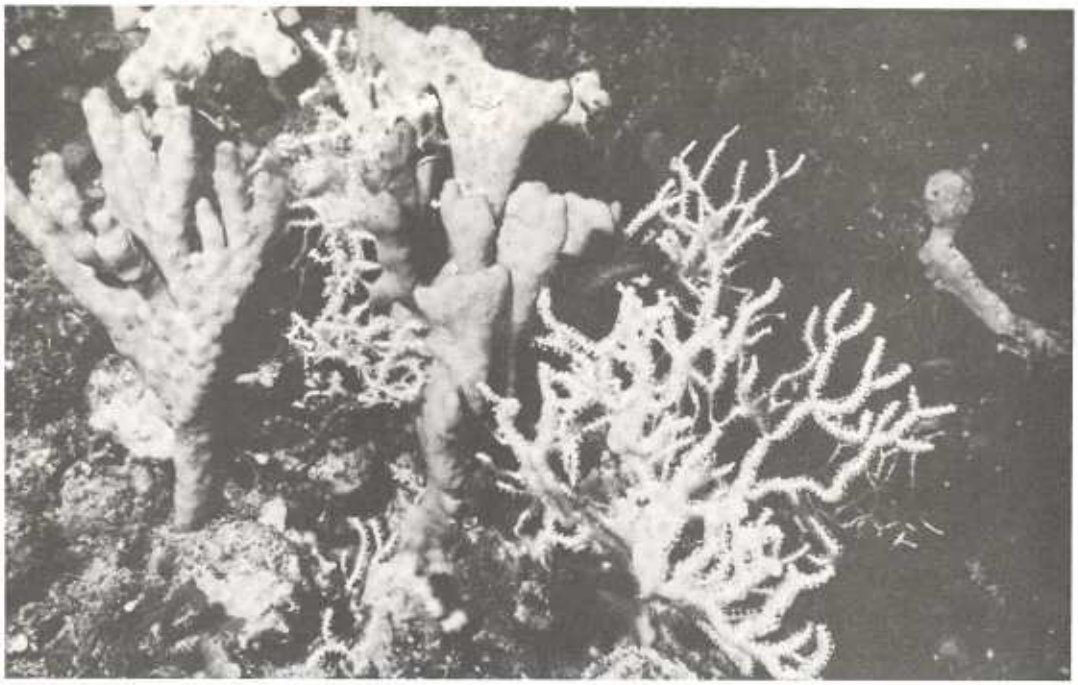


Plate 4.2 Benthic faunal assemblage at Sarah Island (10 m depth).

Plate 4.3 Sea pen *(Sarcoptilus grandis)* on soft sediments at 16 m depth at Sarah Island.

Plate 4.4 Basket star *(Conocladus australis)* attached to sea whip *(Primnoella australasiae)* at Sarah Island (Depth 20 m).

Below the seapens the substratum slopes more steeply and patches of reef reappear. The dominant benthic species on these reefs are gorgonians *(Mopsea encrinula* and *Acabaria gracillima)*, seawhips *(Primnoella australasiae)* with large numbers of attached basket stars *(Conocladus australis)* (Plate 4.4), and several species of bryozoans.

Celery Top Island

Bathurst Harbour has the superficial appearance of a freshwater ecosystem because of the lack of conspicuous algae in the sublittoral fringe. Closer inspection, however, reveals an estuarine community within the intertidal zone and a marine community below the halocline (which seasonally varies from 2 to 4 metres depth). Thomson (1978a,b) found that salinities below the halocline were relatively constant throughout the year (c. 32.4‰), while surface salinities ranged from 7.7‰ in winter to 14.5‰ in summer (at Platypus Point).

The intertidal zone has a very low species diversity. Only five species (the algae *Enteromorpha intestinalis* and *Hormosira banksii*, the seagrass *Heterozostera tasmanica*, the mussel *Xenostrobus pulex*, and the barnacle *Elminius modestus)* are conspicuous between high and low water marks. The number of cryptic species found during the survey was also low; comprising the crabs *Paragrapsus gaimardii* and *Cyclograpsus granulosus*, the shrimp *Macrobrachium intermedium*, the isopod *Ligia australiensis* (near high water mark), and the eel *Anguilla australis*.

A boundary at approximately the level of the halocline separates two subtidal communities. Large areas of coarse-grained sediment in the upper sublittoral zone are covered by the filamentous alga *Cladophora* sp. Rocks, boulders and submerged logs in this zone are generally isolated from each other by soft substratum and are colonised by the mussels *Xenostrobus securis* and *Mytilus edulis*, the barnacle *Elminius modestus*, and the limpet *Notoacmaea flammea*. The bivalve *Irus grisea* is extremely abundant within the sediment. Among the motile animals in this zone are *Favonigobius tamarensis* and an undescribed species of *Nesogobius*, the toadfish *Torquigener glaber*, and the crab *Paragrapsus gaimardii*.

The substratum in the lower sublittoral zone consists of a very fine, black ooze. Just above the surface of the ooze the water was found by Thomson to be c. 75% saturated with oxygen, but no oxygen appears to be present within the sediment itself as metallic objects quickly turned black when placed in this reducing environment. An occasional *Echinocardium cordatum* test could be seen on the surface of the sediment, however no living animals of any species were observed in this zone. Dogfish *(Squalus acanthias)*, nevertheless, are very abundant at depth in Bathurst Harbour as over 50 animals were captured in a single gillnet set overnight.

4.3.4 Port Davey Fish Community

Fishes collected or reliably sighted during ichthyological surveys within the Port Davey region (including surveys conducted by Peter Last and Barry Hutchins as well as the present survey) are shown in Appendix 2.

In common with the open coast community, the fish fauna of Port Davey is depauperate and largely consists of species which are abundant on the eastern Tasmanian coast. The presence of two net susceptible species *(Latris lineata* and *Parascyllium ferrugineum)* is noteworthy because it indicates that gillnets must be set relatively infrequently within the region.

The shelter of Port Davey, and possibly also the greater water temperatures over summer, has allowed a number of species not seen along the south coast to survive. Notable amongst these fishes are the reef associated species *Pseudolabrus tetricus, Cheilodactylus nigripes, Pictilabrus laticlavius* and *Penicipelta vittiger*. Other fishes reliant on the shelter of Port Davey are associated with seagrass beds (e.g. *Acanthuluteres spilomelanurus, Stigmatopora argus, Heteroclinus perspicillatus, Cristiceps australis, Gymnapistes marmoratus* and *Leptonotus semistriatus)*. Despite only one species of seagrass *(Heterozostera tasmanica)* being found within the region, this plant covers large areas of sedimentary substratum in shallow bays, particularly Kelly Basin and Hannant Inlet. Populations of many of the fish species associated with seagrass beds in Port Davey are probably isolated from populations elsewhere in the State. The importance

of the Port Davey seagrass beds as nursery grounds for commercially valuable fish is unknown at present, although it may be considerable because no other large expanses of seagrass are present between Recherche Bay and Macquarie Harbour.

4.3.5 Biogeography and Ecology

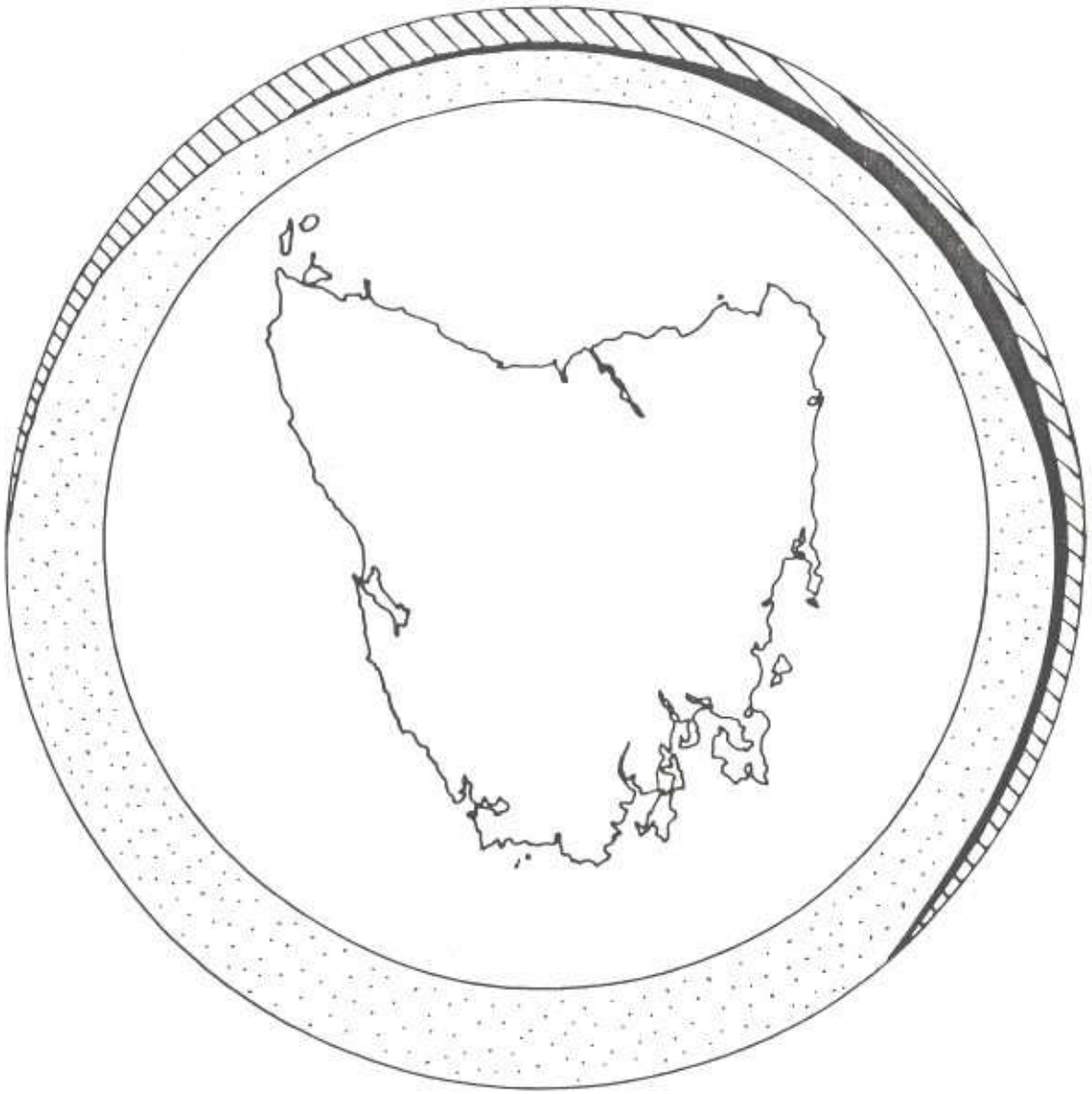
The intertidal zonation patterns found during this survey generally agree with those described for exposed coasts of Tasmania by Bennett and Pope (1960), despite the fact that those authors only visited one site (Maatsuyker Island) between Cape Sorell and Cape Bruny. The lack of barnacles at Maatsuyker Island provided one source of discrepancy, as it resulted in Bennett and Pope concluding that this group was absent or insignificant in southern waters. Barnacles certainly decline in importance from the north of Tasmania to the south, and from South East Cape to the west, but *Catomerus polymerus* is still extremely abundant in South Cape Bay. At Sarah Island (near the entrance to Melaleuca Channel) four species of barnacle (viz. *Catomerus, Chamaesipho columna, Tetraclitella purpurascens* and *Epopomella simplex)* were found, with a further species *(Elminius modestus)* commonly collected in more sheltered areas of Melaleuca Channel. *Chthamalus antennatus,* a conspicuous intertidal organism in warmer waters of Tasmania, Victoria, South Australia and New South Wales, was not found on the southern coast although a few specimens were sighted on rocks in Recherche Bay.

A list of the dominant and conspicuous species in South West Tasmania (Table 4.4) indicates that the marine biota differs considerably from that occurring in South Australia or New South Wales. The great majority of the common species rarely occur outside the Tasmanian and Victorian region (27 of 44 species), while a number of species are endemic to Tasmania (e.g. *Mendesoma allporti, Lessonia corrugata* and *Xiphophora gladiata).* Moreover, all of the common species which occur in New South Wales or South Australia as well as in southern Tasmania are nearing tolerance limits in one of the regions, and in the warmer states are either much more *(Catomerus polymerus, Chaemosipho columna, Phyllospora comosa, Ecklonia radiata, Actinia tenebrosa)* or less abundant *(Cellana solida, Haliotis ruber, Jasus novaehollandiae, Petricia vernicina, Nectria ocellata, Rivularia firma, Cystophora platylobium, Poneroplax costata, Pseudophycis*

barbata, Bovichthys variegatus, Aracana aurita, Sypharochiton pelliserpentis). This reinforces the contention that a separate cool temperate province (the Maugean) exists and is centred on the eastern, southern and western coasts of Tasmania (Fig. 4.5).

Table 4.4 Marine species which are abundant in south-west Tasmanian coastal waters. Species rarely found in Australia outside the Maugean biogeographic province are denoted by (M).

Algae	Molluscs
Rivularia firma	*Littorina praetermissa* (M)
Gigartina ancistroclada (M)	*Cominella lineolatus* (M)
Cystophora platylobium	*Notoacmaea mayi* (M)
Cystophora xiphocarpa (M)	*Lepsiella vinosa* (M)
Lithophyllum hyperellum (M)	*Siphonaria tasmanica* (M)
Durvillaea potatorum (M)	*Patelloida latistrigata latistrigata* (M)
Xiphophora gladiata (M)	*Cellana solida*
Lessonia corrugata (M)	*Patellanax peroni* (M)
Phyllospora comosa	*Patelloida victoriana* (M)
Ecklonia radiata	*Poneroplax costata*
Macrocystis pyrifera (M)	*Sypharochiton pelliserpentis*
Fish	*Brachidontes rostratus* (M)
Pseudophycis barbata	*Siphonaria diemenensis* (M)
Trachinops caudimaculatus (M)	*Haliotis ruber*
Latridopsis forsteri (M)	Crustaceans
Cheilodactylus spectabile (M)	*Cyclograpsus granulosus* (M)
Bovichthys variegatus	*Paragrapsus quadridentatus* (M)
Latris lineatis (M)	*Jasus novaehollandiae*
Aracana aurita	Barnacles
Mendesoma allporti (M)	*Chamaesipho columna*
Dactylosargus arctidens (M)	*Catomerus polymerus*
Pseudolabrus fucicola (M)	Anemones
Sea Stars	*Actinia tenebrosa*
Patiriella exigua (M)	
Petricia vernicina	
Nectria ocellata	



FLINDERSIAN

PERONIAN

MAUGEAN

Fig 4.5 The relative
different bi
elements to
marine biota

4.4 South West Fishery

4.4.1 Abalone

Abalone is the most valuable of currently exploited marine resources in South West Tasmania, with a wholesale value in 1980 estimated at 6.7 million dollars (Arundell *et al.* 1980). Approximately 850 tonnes per year (42% of the total Tasmanian abalone catch) is taken along the south-western coast between Macquarie Harbour and Dover.

Catches in all five fishery blocks (Fig. 4.1) within the region are considerable, with maximum yields being taken from the three southern, most heavily exploited blocks (Table 4.5).

The catch per unit effort (kilograms of abalone/diving hour) is 50% better for South West fishermen than for divers elsewhere in the State (79.3 cf. 55.8 kg/hour), presumably because abalone stocks are protected from overexploitation by the unreliable sea-state and difficulty of access. Due to the very poor weather conditions experienced in the area between April and October, the divers effort and hence catch is comparatively low at this time (Table 4.6). A large number of divers move from fishing the South West to other parts of the State over winter (Fig. 4.6). This seasonal change in effort, however, is most apparent for west coast waters and is barely evident along the southern coast (Fig. 4.7).

4.4.2 Rock Lobster

The rock lobster catch from the South West represented 21.5% of the Tasmanian catch in 1980 and was valued at 2.68 million dollars (Arundell *et al.*, 1980).

The mean annual catch statistics presented in Table 4.7 indicate that the largest catches were taken in the southern zone (Zone 4346, Fig. 4.1) where effort was greatest, however significant catches were also recorded along the west coast. The catch per unit effort (weight of rock lobster per potlift) was, in fact, maximal on the western rather than the southern coast. Somewhat surprisingly,

Table 4.5 Mean annual abalone catch, effort and catch per unit effort in different fishery blocks, 1968 - 1978 (from Arundell *et al*, 1980).

BLOCK	EFFORT (DIVER HOURS)	CATCH (LIVE TONNES)	CATCH/EFFORT RATIO
9	1012.1	96.3	95.1
10	1441.2	142.3	98.7
11	2125.5	183.5	86.3
12	2041.7	171.7	84.1
13	3613.2	217.7	60.3
AREA TOTAL	10233.7 (32%)	811.5 (40%)	79.3
REMAINDER OF STATE	21423.3 (68%)	1194.8 (60%)	55.8
STATE TOTAL	31657.1	2006.3	63.4

Table 4.6 Mean monthly catch, effort and catch per unit effort from the South West, 1968 - 1978 (from Arundell *et al*, 1980).

MONTH	CATCH (Kg LIVE)	EFFORT (DIVER HOURS)	CATCH/EFFECT RATIO
JAN.	121 792	1 395	87.3
FEB.	102 812	1 218	84.4
MARCH	90 566	1 054	85.9
APRIL	39 130	575	68.1
MAY	58 792	768	76.5
JUNE	47 457	649	73.2
JULY	44 149	594	74.4
AUG.	44 112	627	70.4
SEPT.	48 257	687	70.3
OCT.	54 257	737	73.9
NOV.	111 772	1 219	91.7
DEC.	79 800	878	90.9

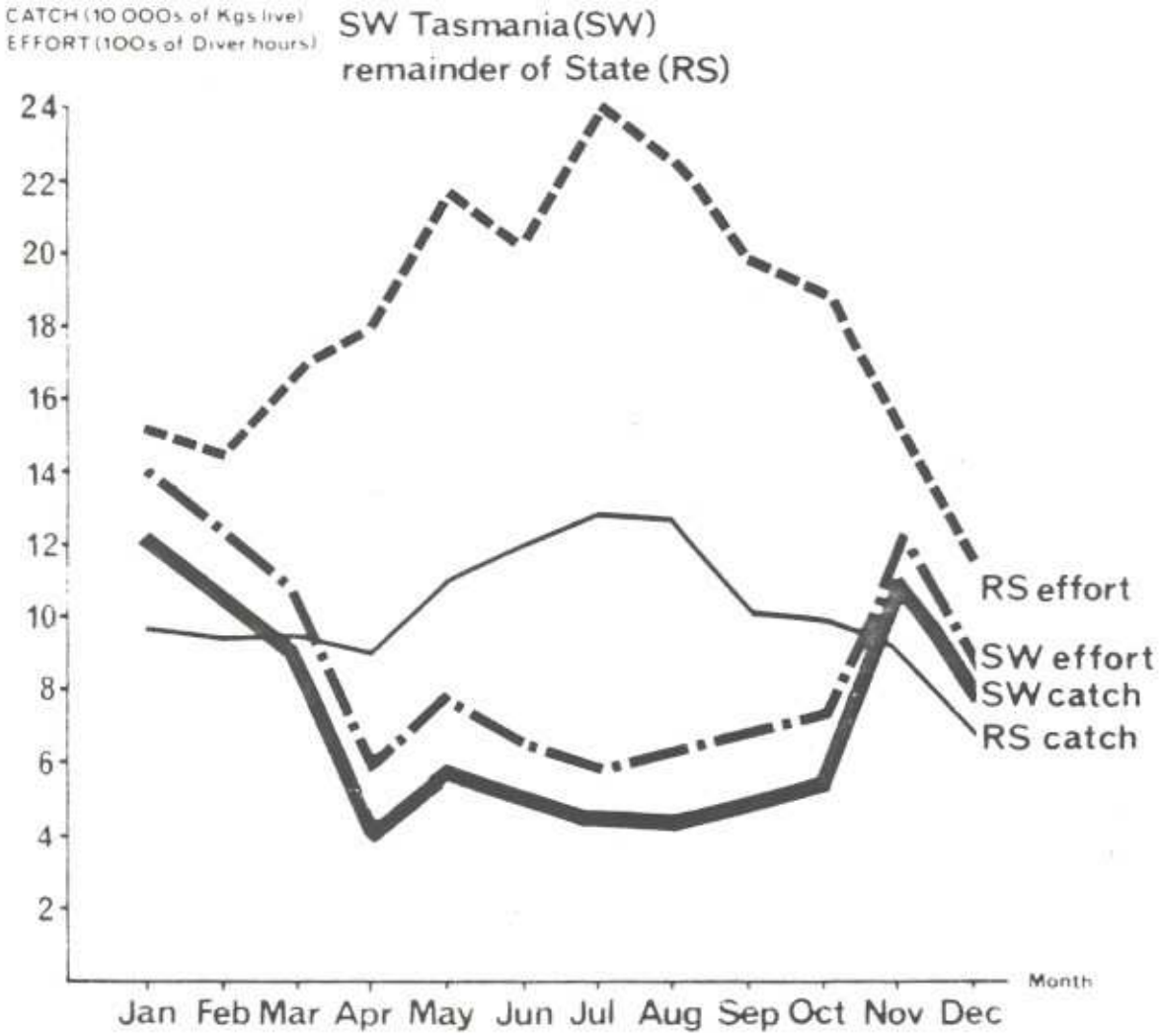


Fig 4.6 Monthly mean abalone catch and effort, July 1968 - June 1979 (from Arundell *et al.*, 1980).

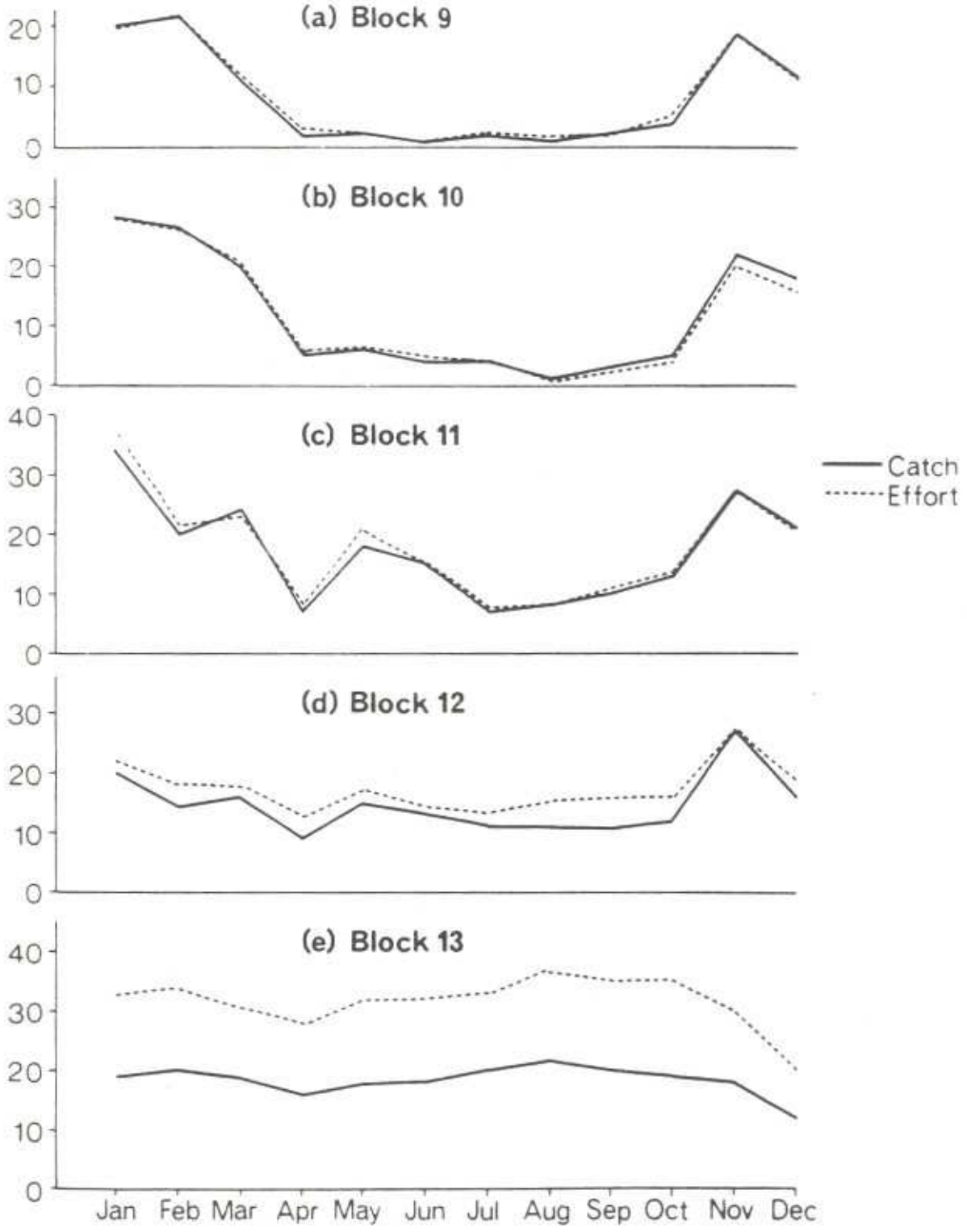


Fig 4.7 Monthly mean abalone catch (tonnes) and effort (diver hours x 10) by fishing block, July 1968 - Dec. 1978 (from Arundell *et al.*, 1980).

Table 4.7 (from Arundell *et al*, 1980)

SOUTH WEST TASMANIA - MEAN ANNUAL STATISTICS

JULY 1967 - DECEMBER 1978

ROCK LOBSTER

Fishery Block	4244	4245	4345	4346	Zone	Res St
Weight	6 223.4	90 264.9	89 625.2	133 432.6	319 497.1	1 16
Number	7 305.5	110.865.0	114 737.5	175 715.9	408 560.8	1 30
Potlifts	5 455.7	64 194.2	69 890.8	112 132.1	251 225.9	87
Boat Days	74.4	857.9	952.7	1 621.3	3 508.9	2
Days	132.5	110.0	103.2	128.0	122.7	
Mean Weight	.852	.814	.781	.759	.782	
Weight/Potlift	1.141	1.406	1.282	1.190	1.272	
Weight/Boat Day	83.6	105.2	44.1	82.3	91.1	

Arundell *et al.*(1980) considered that the South West fishery is more heavily exploited than fisheries elsewhere in Tasmania because both the mean weight of animals and the catch per potlift are significantly lower in the South West.

The rock lobster catch varied seasonally in a similar way to the abalone catch because both were dependent on weather conditions (Fig 4.8). Very poor catches were taken between April and August. South West Tasmanian waters are closed completely for rock lobster fishing in the months of September and October, and only male rock lobsters are allowed to be taken between June and August.

4.4.3 Other Fisheries

Information on the catches of demersal and pelagic fish species in South West Tasmania is given by Arundell (1980). The mean annual catch of these species from the South West is comparatively poor (only 164 tonnes, representing 5.4%, of the total Tasmanian catch). The relative contributions of the major fish species to the total catch in each fishery block (which correspond with rock lobster fishery blocks, Fig 4.1) are shown in Fig. 4.9. At present, shark (both school and gummy) provides the mainstay of the South West demersal fishery in both weight and value of catch. A large jack mackerel catch (290 tonnes) which was taken in 1973/74 during a Russian experimental trawling programme is also notable as it indicates that very large stocks of this resource are present off the South West coast. However, the low retail price of this species and the lack of processing facilities for fish meal precludes an economically viable fishery in jack mackerel at present. Both shark and jack mackerel, as opposed to abalone and rock lobster, are caught offshore and catches would not be affected by inshore marine reserves.

The quantity of other fish species taken in the South West is currently almost negligible, although a number of species such as skipjack tuna, orange roughy and various species of dory have been caught in economic quantities during experimental programmes. These fish may be exploited at some future date.

Waterman (1978, 1980) discussed a number of other possible marine resources in South West Tasmania, however these resources have

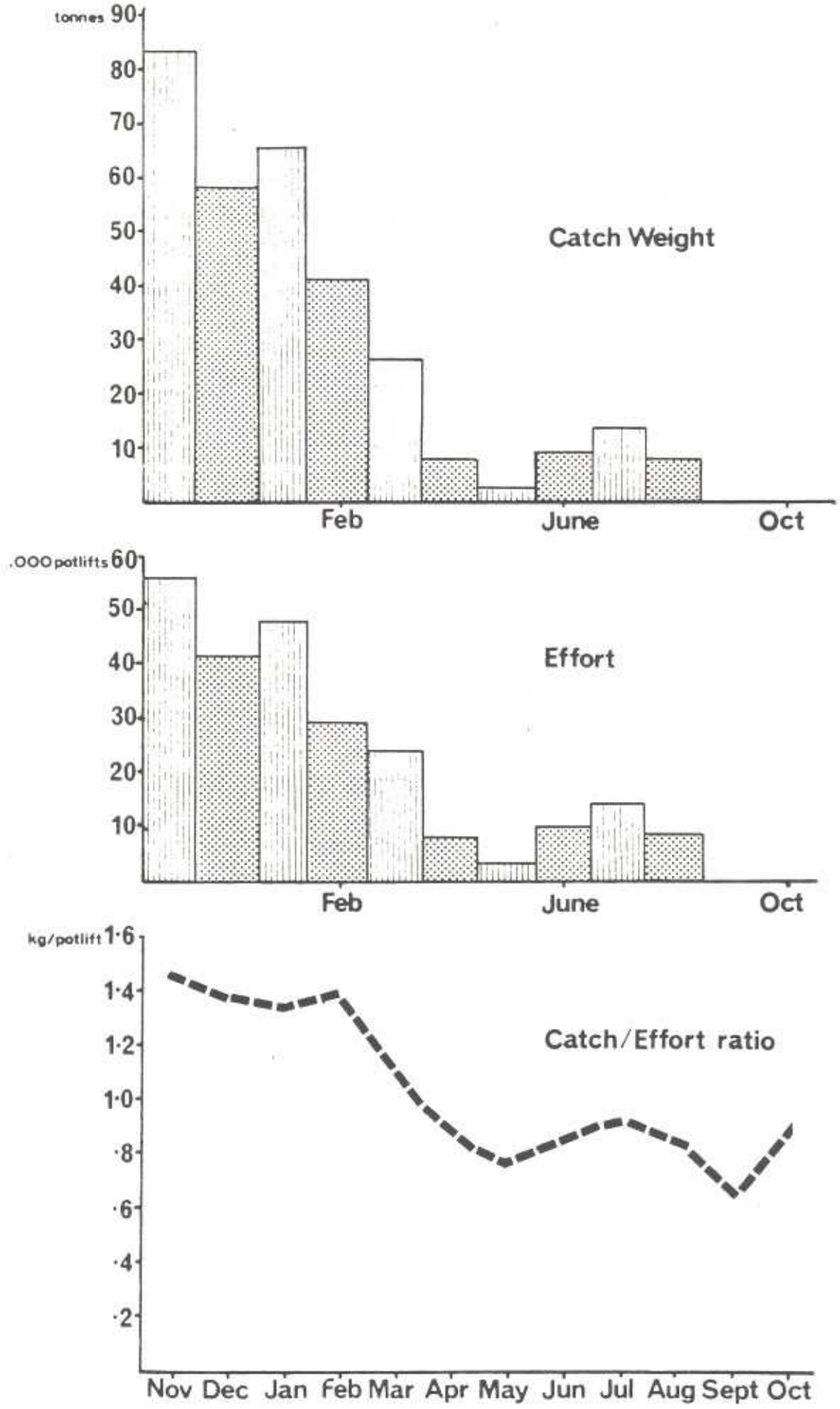


Fig 4.8 Monthly South West Tasmania rock lobster catch and effort (from Arundell *et al.*1980).

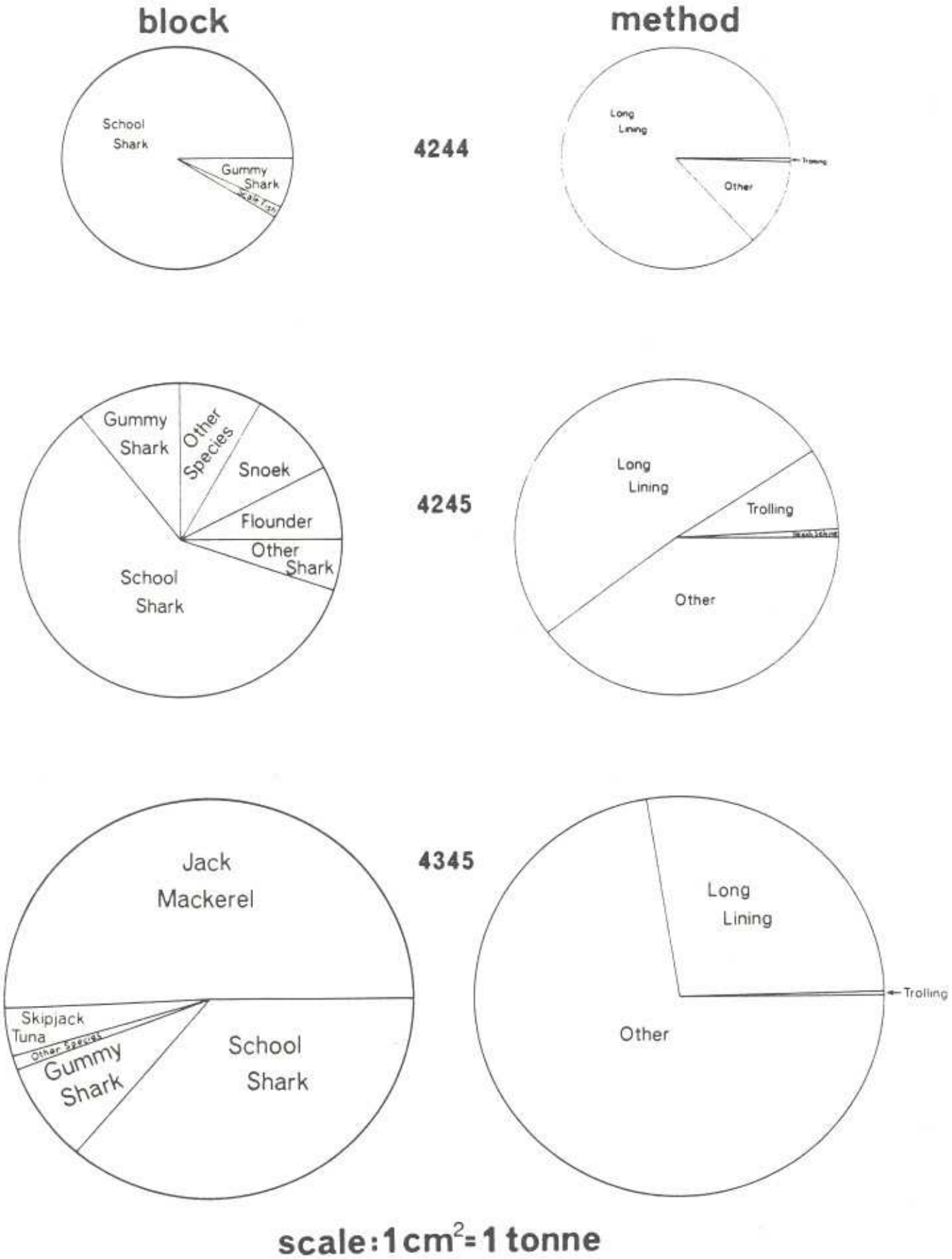
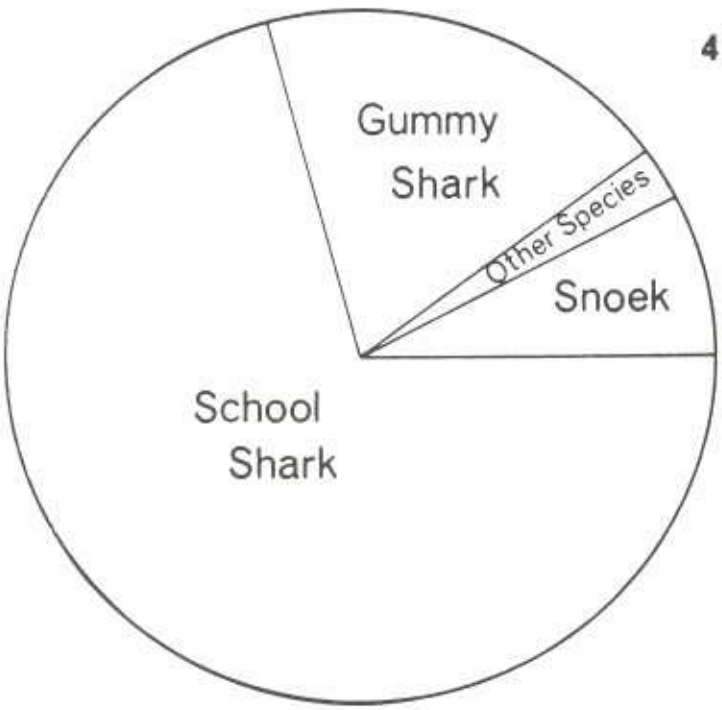


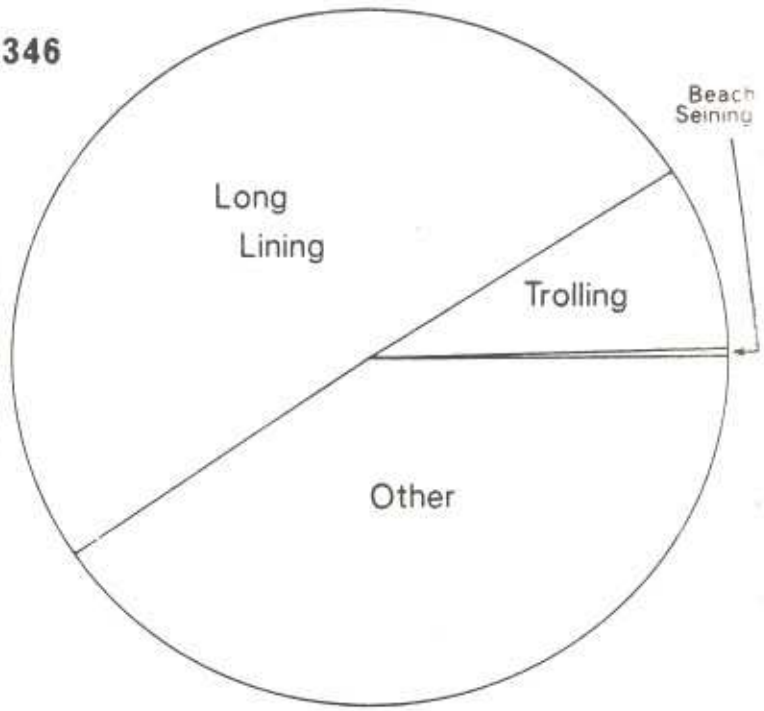
Fig 4.9 Fish catches in different fishery blocks (from Arundell, 1980).

block **method**

9607



4346



scale: 1 cm^2 = 1 tonne

Fig 4.9 Continued

either not been found in large quantities (sea urchins, squid, giant crab, stone crab, scampi and octopus) or cannot be exploited on economic grounds (kelp and krill).

4.5 Marine Reserve Recommendations

The underwater habitats of Port Davey and Bathurst Channel are presently protected by Southwest National Park legislation. There is little need at present for fisheries restrictions in this area, or a marine reserve being declared elsewhere in the south-west Tasmanian region, for the following reasons : -

(i) Restrictions on the capture of rock lobster or abalone in this area would be difficult to justify because of the serious economic loss this could entail,

(ii) Access difficulties and the unreliable weather conditions would prevent the public from receiving any significant recreational or educational benefits from marine reserves along the open coast,

(iii) Almost all of the species found along the exposed southern and western coasts are also present along the eastern Tasmanian coast, and would be preserved if the 1981 proposal for a Maria Island marine park is accepted,

(iv) The South West coastal ecosystem does not presently appear threatened. A marine reserve could be declared in the future if the public considers that scientific and recreational benefits would be gained from the preservation of a representative sample of southern Tasmanian marine life.

The Bathurst Channel region was alone among the south-west Tasmanian areas surveyed in offering considerable potential as a marine reserve. The benthic faunal community found in this area is particularly interesting scientifically because of the unusually shallow depth of the benthic fauna and the paucity of fishes, and is also valuable as a recreational resource because of the colour and variety of the many species of sedentary animals. It provides recreational divers with an enjoyable change from the kelps which dominate other

inshore Tasmanian marine habitats. Fortunately, this community does not appear threatened in any way, and the underwater habitat, shoreline and adjacent terrestrial environment are protected from degradation by Southwest National Park legislation. The Bathurst Channel community is also under very little fishing pressure. Professional fishermen do not exploit the area due to a low abundance of fish and an absence of abalone. Rock lobster fishermen also are prevented from entering the Channel because the salinity of the surface water is so low that it kills rock lobsters stored in flowthrough holds. Hence, despite the significant recreational and scientific attractions, little would be gained by introducing particular restrictions in Bathurst Channel.

5. THE BICHENO REGION

5.1 Introduction

Although a number of areas on the east Tasmanian coast were included in the 1980 marine survey (Edgar, 1981) the Bicheno region was not investigated because of the lack of terrestrial National Parks in the vicinity. However, a number of areas near Bicheno have since been suggested by local residents, and Hobart and Launceston diving groups, to be potential marine reserve sites. Consequently, a limited marine survey of the area was undertaken.

The area investigated extended along c. 5 km of coast from Diamond Island to Farm Point, and included the small offshore rocks and islands (Fig. 5.1). After a preliminary inspection it was apparent that two sections of the coast were particularly worthwhile considering as potential marine reserve sites. These areas, Governor Island and eastern Waubs Bay, differ in a number of respects and are discussed separately after a general description of the Bicheno marine environment.

5.2 The Physical Environment

A coarse-grained, granite bedrock, which forms part of the large north-east Tasmanian Devonian batholith, outcrops throughout the Bicheno region. This granite fractures underwater into large blocks which often overlie each other to form caves and fissures.

Wave exposure along the eastward facing coast from Governor Island south to Farm Point is submaximal, however the rocky shore of Waubs Bay and areas sheltered by offshore reefs and islands are moderately exposed grading to sheltered open coast. Wind speeds and directions at Bicheno are presumably similar to those recorded at the Swansea meteorological station (see Fig. 7 in Edgar, 1981) where the prevailing winds are from an easterly direction in summer and westerly in winter. Water clarity within the area exceeds 30 m for much of the period between April and July because of the offshore nature of these prevailing westerly winds, and the low rainfall and minimal runoff in the region.

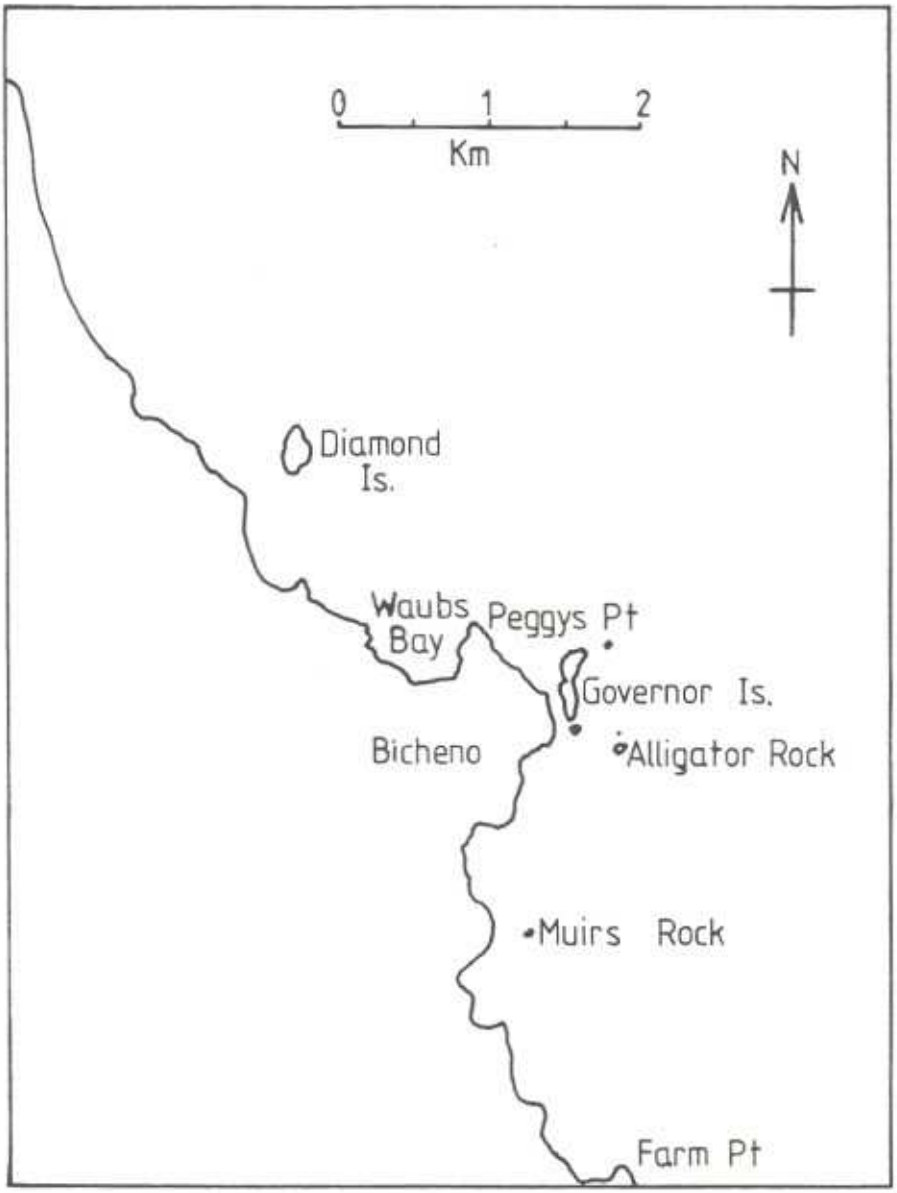


Fig. 5.1. The Bicheno region.

Tides at Bicheno are semidiurnal with a low amplitude (approximately 0.9 m between high and low water marks).

5.3 The Biological Environment

The relationship between wave exposure and the depth of subtidal assemblages in the Bicheno region is similar to that elsewhere on the Tasmanian east coast (see Edgar, 1984). In submaximally exposed regions the brown algae *Xiphophora gladiata* occurs in the lowermost part of the intertidal zone. Bull kelp *(Durvillaea potatorum)* extends from the sublittoral fringe to a depth of c. 2 m and then merges with *Lessonia corrugata* and/or *Phyllospora comosa*. These two brown algae range to about 8 m and are followed by an assemblage of *Ecklonia radiata, Acrocarpia paniculata,* red algae and invertebrates. Below 25 m depth few plants are present and the reef is covered by sponges, gorgonians and ascidians (Plate 5.1). These sedentary animals, with the green alga *Caulerpa brownii,* yellow zoanthids, the jewel anemone *Corynactis australis* and the barnacle *Megabalanus nigrescens* also occur on vertical rock substrata in more shallow water. In moderately exposed areas, the width of the *Durvillaea* and *Lessonia/Phyllospora* zones are contracted with *Durvillaea* being absent from the most sheltered regions.

Between the depths of 1 and 3 m along the moderately exposed western side of Peggys Point, large patches of the elongate brown algae *Cystophora xiphocarpa* and *Cystophora moniliformus* are present, and giant kelp *(Macrocystis pyrifera)* beds also occur in this area in depths of 7 to 10 m. Sparse stands of the seagrass *Heterozostera tasmanica* grow on the soft substratum beside the reef.

A diverse fish fauna is associated with the wide range of habitats, which vary in wave exposure from sheltered to submaximal. On the sandy bottom of Waubs Bay, species such as the greenback flounder*(Rhombosolea tapirina),* butterfly gurnard *(Lepidotrigla vanessa),* red mullet *(Upeneichthys vlamingii),* gurnard perch *(Neosebastes scorpaenoides),* silverbelly *(Parequula melbournesis)* and sand flathead *(Platycephalus bassensis)* are abundant. The most

common reef fishes in the more sheltered habitats are purple wrasse *(Pseudolabrus fucicola)*, blue-throated wrasse *(Pseudolabrus psittaculus)*, senator fish *(Pictilabrus laticlavius)*, trumpeter *(Latridopsis forsteri)*, red rock cod *(Scorpaena ergastulorum)*, toothbrush leatherjacket *(Penicipelta vittiger)*, mado *(Atypichthys strigatus)*, sea pike *(Dinolestes lewini)* and trachinops *(Trachinops caudimaculatus)*. Several cave dwelling species such as cardinal fish *(Vincentia conspersa)* and bullseyes *(Pempheris multiradiata)* also occur in this area while jack mackerel *(Trachurus declivis)* seasonally pass through in considerable numbers. A large proportion of the sheltered reef species are also conspicuous in more exposed habitats, where they co-occur with sea carp *(Dactylosargus arctidens)*, banded morwong *(Cheilodactylus spectabile)*, brown-striped leatherjacket *(Meuschenia australis)*, butterfly perch *(Caesioperca lepidoptera)*, boarfish *(Pentaceropsis recurvirostris)* and sweep *(Scorpis lineolatus)*.

5.4 Governor Island

Governor Island is a low-lying, granitic islet approximately 500 m long by 100 m wide located 100 m east of the port of Bicheno. The island is an important seabird rookery with one of the largest populations of breeding crested terns reported from Tasmania. Increasing numbers of birds have been recorded in recent years, with approximately 1,000 pairs of crested terns *(Sterna bergii)*, 500 pairs of silver gulls *(Larus novaehollandiae)*, 2 pairs of sooty oystercatchers *(Haematopus fuliginosus)*, and a few pairs of pacific gulls *(Larus pacificus)* nesting on the island in late 1983 (E. Woehler, J. Napier, pers. comm).

The marine life inhabiting the reefs off the eastern shore of Governor Island is also extremely interesting, both scientifically and recreationally. This is because an unusual topographic combination of vertical and near vertical rockfaces and caves has allowed a considerable number of benthic plant and animal communities to develop in a very limited area. One of these communities, which occurs in water depths exceeding 20 m off the north-eastern corner of Governor Island, is particularly noteworthy because it is composed of a colourful variety of sedentary animals such as seawhips, seafans, anemones, hydroids, sponges and yellow zoanthids. Large numbers of fish such as

Plate 5.1 Benthic faunal assemblage at 22 m depth at Governor Island.

Plate 5.2 Sea anemone *(Phlyctenanthus australis)* and sponges in cave off north-western Governor Island (19 m depth).

Plate 5.3 SCUBA diving instruction at Waubs Bay, Bicheno.

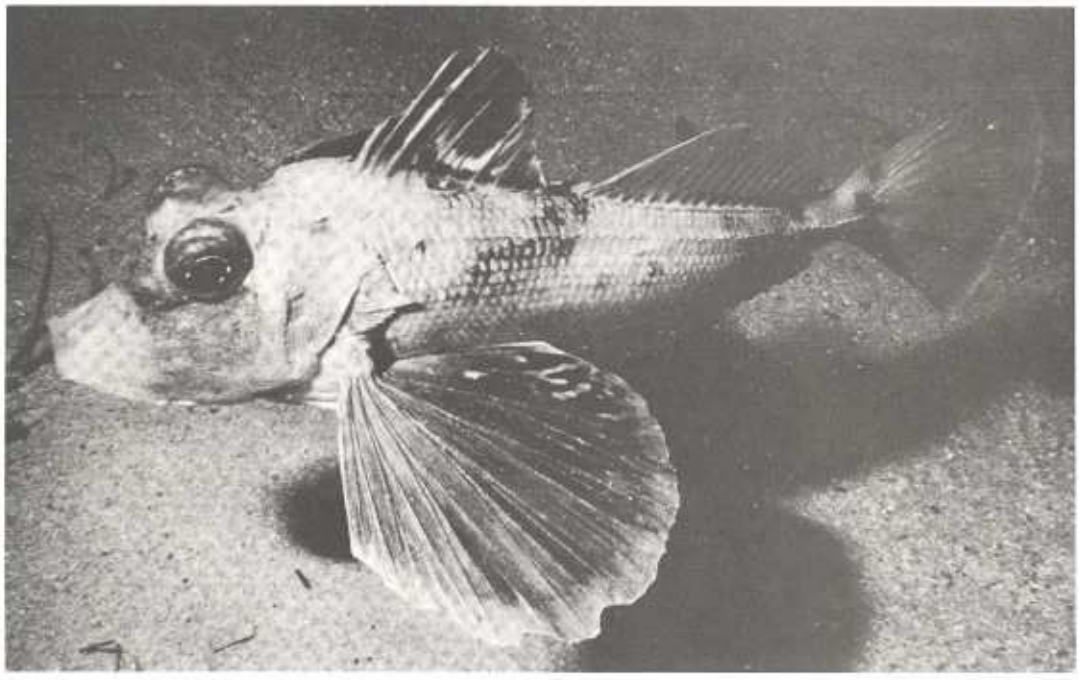


Plate 5.4 Butterfly gurnard *(Lepidotrigla vanessa)* on the floor of Waubs Bay.

butterfly perch *(Caesioperca lepidoptera)*, red gurnard perch *(Helicolenus papillosus)*, boarfish *(Pentaceropsis recurvirostris)* and cod *(Lotella rhacinus* and *Pseudophycis* spp.), and invertebrates such as basket stars *(Conocladus australis)* and feather stars can be seen moving through this habitat. It is possible that similar faunal communities occur in deep areas (> 30 m) with considerable water movement in other localities along the eastern Tasmanian coast, however they are yet to be found elsewhere in such shallow water or in a region so readily accessible to recreational divers. A second attraction for divers in the same area as this animal community is a 2 m high underwater cave which passes for 30 m from one side of a granitic column to the other. Large numbers of fish, particularly bullseyes, sandpaper fish and beardies, are found within this cave.

Other spectacular underwater caves of larger dimensions are located in depths of about 8 m off the northwestern corner of the islet, locally known as "Bird Rock", which occurs 50 m north of Alligator Rock. The walls of these caves are covered by a variety of sedentary animals such as sponges, jewel anemones and barnacles, and many large fish such as boarfish, zebrafish *(Melambaphes zebra)* and blue-throated wrasse *(Pseudolabrus tetricus)* are also present. These fish are inquisitive, approaching the diver and providing easy targets for the occasional spearfisherman who visits the area.

Two amateur fishing activities, gill-net fishing and rock lobster potting, as well as spearfishing take place off Governor Island, particularly during holiday periods. Gill-net fishing is not often carried out on the eastern side of Governor Island because of currents, wave surge and the rugged terrain, however professional fishermen work this area for rock lobsters and abalone. A sheltered channel (The Gulch) lies between the western shore of Governor Island and the mainland. This is one of two mooring sites for boats in the Bicheno region (with Waubs Bay), with a boatramp, fish processing factory and oyster hatchery present on the landward shore.

5.5 Eastern Waubs Bay

Habitats within Waubs Bay range from sand through seagrass beds to sheltered and moderately exposed rocky reef. One feature within the bay of particular interest is a shear-sided rock rising 10 metres from the seabed at 18 m depth. The sides of a deep crevice which splits "The Rock", and to a lesser extent the outer walls of the reef, are covered by an attractive community of benthic invertebrates, and an abundant associated fish fauna is also present. It is surprising that such a reef occurs in sheltered waters, although similar habitats occur along more exposed sections of the Tasmanian east coast.

Eastern Waubs Bay is extensively used by SCUBA diving instructors (Plate 5.3) as one of the three major diver training areas in Tasmania (with Wynyard and Tinderbox). An average of approximately 10 people per day dive in the bay. They are attracted to the area by the variety of underwater habitats and diverse fish life, and the safe and sheltered diving conditions. The great diversity of fishes is shown by the fact that 55 species were recorded in Waubs Bay during six days diving. This compares with 56 species recorded during an equivalent number of diving days at Rocky Cape, the most diverse region investigated during the 1980 marine survey.

The primary reason for declaring a marine reserve in eastern Waubs Bay would be to increase the abundance of fish and thus enhance the recreational value of the area.

Fishermen could also benefit after the declaration of a marine reserve because fish, abalone and rock lobster numbers would be expected to increase, resulting in an emigration of eggs, larvae and adults which are then available for capture outside the reserve. It should be noted, however, that these gains would be modest because of the limited size of the reserve and probably would not compensate for the loss of fishing grounds. Although both amateur and professional fishermen utilise the area, the total catch taken from the bay by amateurs appears to greatly exceed that taken by professionals. Amateurs occasionally place rock lobster pots on the western shore of

Peggys Point, however spearfishing and the setting of gill-nets probably have the greatest influences on the reef community. Professional fishermen set gill-nets irregularly, perhaps two or three times a year when mullet or mackerel are passing through the area, to augment the bait supplies for their rocklobster pots. Very little, if any, professional fishing for abalone or rocklobster is carried out on reefs in Waubs Bay.

Of greater concern to professional fishermen than the loss of fishing resource is the threat to boat moorings in the event of the declaration of a marine reserve in Waubs Bay. The two moorings closest to the eastern shore of Waubs Bay, particularly the northernmost of these which lies 30 m south-west of "The Rock", probably would need to be relocated because the movement of vessels to and from these moorings represents a hazard to divers swimming near the surface. It would be unwise to attract divers to a marine reserve which was dangerous because of moving boats.

5.6 Marine Reserve Recommendations

5.6.1 Governor Island

It is recommended that a Nature Reserve should be declared at Governor Island. This reserve should include both Governor Island and a marine extension which encompasses the lands both submerged and above water which occur from high water mark for a distance of 300 m eastward from the eastern shore of Governor Island (Fig. 5.2). It is also recommended that the capture of fish using net and the capture of rock lobster by divers be prohibited within the marine extension, but that the taking of fish by handline, the taking of rock lobster by pot and the taking of abalone by divers be allowed.

The above proposal does not interfere with fishermen taking rock lobster or abalone or mooring boats in "The Gulch". It slightly disadvantages the very small number of amateur fishermen who infrequently spearfish or set nets within the area but who can fish outside the zone with little inconvenience. However, the benefits which would

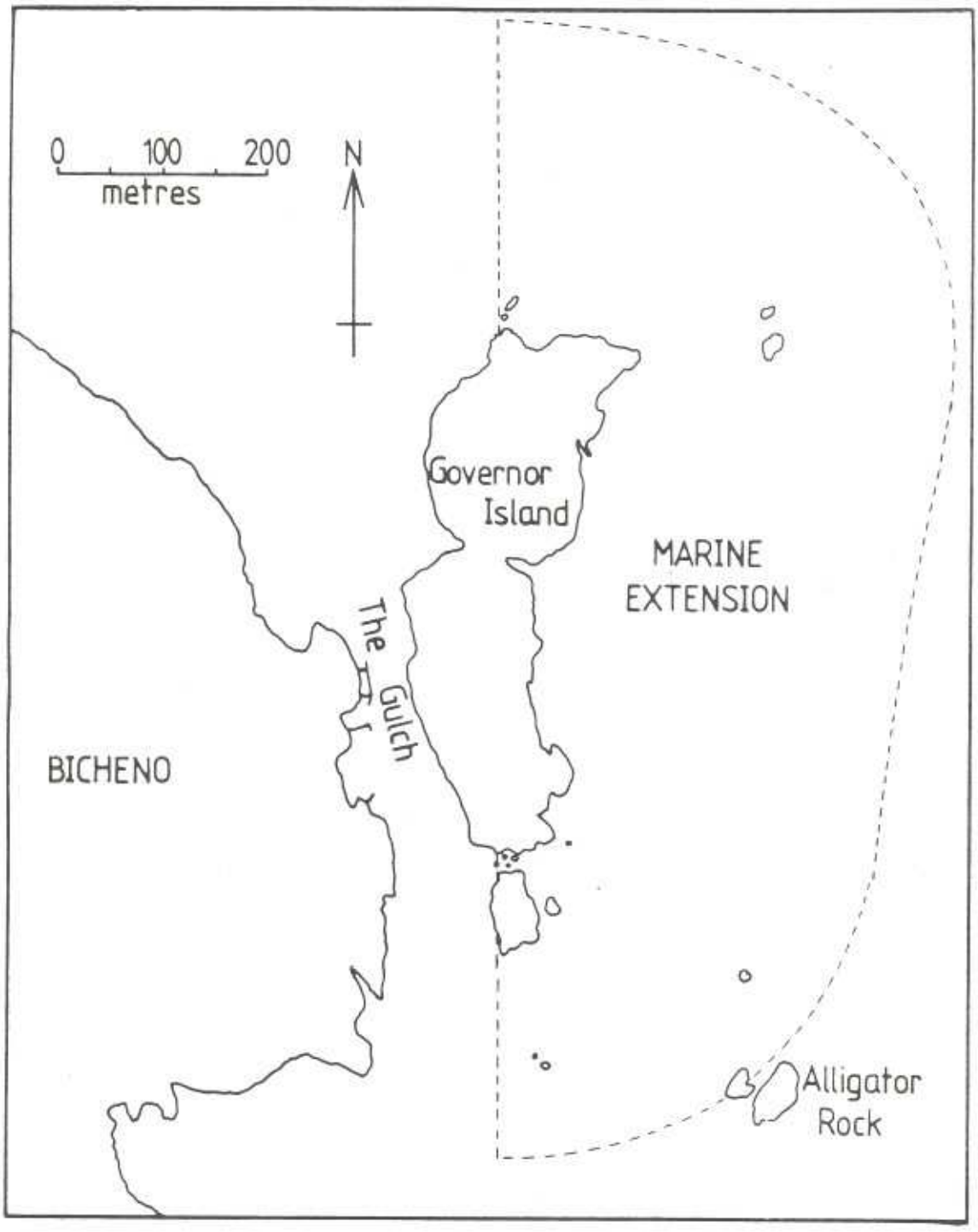


Fig 5.2 Boundaries of proposed Governor Island Nature Reserve.

accrue from such a reserve are considerable and include : -

(i) protection for the large numbers of seabirds which breed on Governor Island;

(ii) protection for a variety of east coast marine communities;

(iii) protection for the scientifically interesting deeper water benthic and cave-dwelling communities of animals;

(iv) enhancing the enjoyment of recreational divers who visit the area;

(v) an increase in the fish stocks available for capture adjacent to the reserve because fish would be expected to become more abundant within the boundaries and an overflow of animals would move outside;

(vi) an increased usage of diving establishments, shops and accommodation in the Bicheno area by the increased number of divers who would be attracted to a marine reserve, and

(vii) providing useful publicity for the marine orientated Bicheno tourist industry.

.6.2 Eastern Waubs Bay

It is not recommended that a marine reserve be declared in Waubs Bay because of a conflict between the aims of a marine reserve and the traditional rights of professional fishermen who moor their vessels within the bay.

However, it should be noted that the usage of Waubs Bay by recreational divers is expected to continue to increase and that some signposting of the foreshore should be carried out to (i) warn divers of possible danger from passing boats, and (ii) warn boat operators of the possible presence of divers in the area and notify them of the maritime regulations regarding divers flags.

6. D'ENTRECASTEAUX CHANNEL

6.1 Tinderbox

6.1.1 Underwater Habitat

Wave exposure in the Tinderbox region varies from moderate exposure at Piersons Point to sheltered conditions in Tinderbox Bay.

The rocky reefs east of Tinderbox Bay generally drop in a series of rock platforms to 6 metres depth. The lower eulittoral zone in this area is dominated by bands of *Polysiphonia* sp., *Ulva lactuca*, *Hormosira banksii* and *Cystophora torulosa*. *Colpomenia peregrina*, *Gelidium australis*, *Champia* sp. and *Lophurella periclados* are present at the lowest levels. The sublittoral zone is occupied by a number of codominant plants. *Acrocarpia paniculata*, *Carpoglossum confluens*, *Cystophora moniliformis*, *Jeannerettia lobata*, *Ecklonia radiata*, *Caulerpa trifaria*, *C. simpliciuscula*, *C. geminata*, *Sargassum bracteolosum*, *S. verruculosum*, *Zonaria turneriana*, and *Z. crenata* are all locally abundant.

The increase in exposure as Piersons Point is approached is indicated by the occurrence of *Xiphophora gladiata* and *Lessonia corrugata* in the sublittoral fringe, and isolated *Macrocystis pyrifera* plants in the sublittoral zone. *Codium fragile* and *Caulocystis cephalornithos* are also present subtidally in this region. *Caulocystis* occurs only in shallow water (to 1 m depth) at these sheltered open coastal sites; a distribution which contrasts with the situation in more sheltered bays where it grows only at greater depths (2 to 5 m depth). Other macro-algae generally show a positive correlation between wave exposure and the water depth in which they grow.

Several cobble beaches occur between the small headlands south of Piersons Point. These cobbles overlie rock platforms which outcrop below low water mark.

The reefs south-west of Tinderbox Beach drop steeply to sand at 5 metres depth, and small caves occasionally develop in the broken bottom. The seagrasses *Heterozostera tasmanica* and *Halophila ovalis* are patchily distributed offshore from shallow caves along this

shoreline, and in Tinderbox Bay. The sublittoral reef flora is dominated by five algae (*Ecklonia radiata, Sargassum verruculosum, Acrocarpi paniculata, Caulerpa geminata* and *Caulerpa trifaria*), while *Plocamium angustum, Halopteris ?funicularis, Carpoglossum confluens, Zonaria* spp., *Cystophora moniliformis, Sargassum* sp., *Macrocystis pyrifera, Caulerpa flexilis* and *Caulerpa simpliciuscula* are slightly less common. A fine, filamentous green alga (*?Cladophora*) also occurs in this area. This species periodically grows profusely and covers both macro-algae and the reef substratum. The mechanisms which trigger the blooms of algae are imperfectly understood, but are probably due to a combination of high levels of suspended solids, nutrients and light.

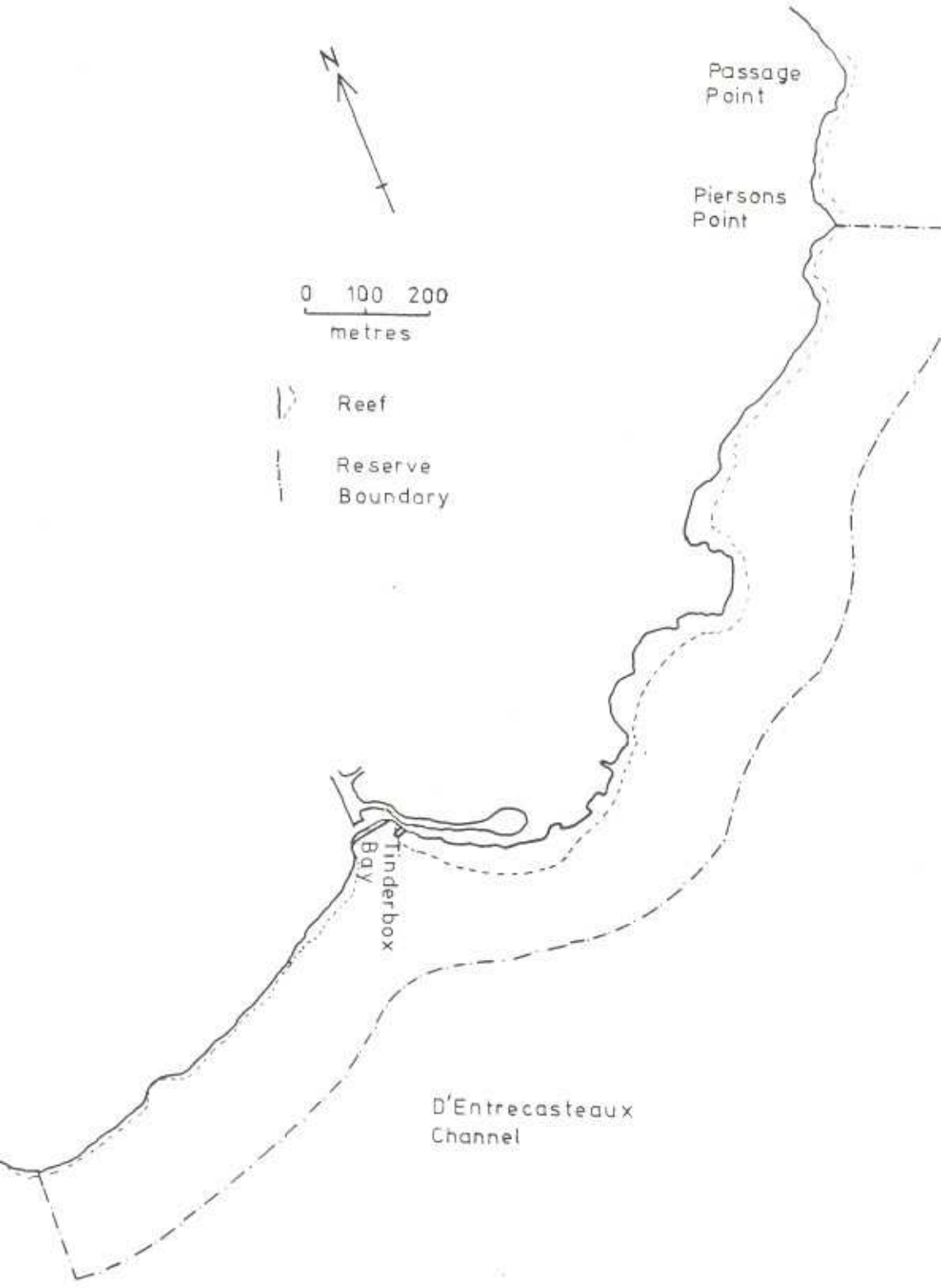
A sheltered flora of *Hemineura frondosa, Cystophora retroflexa, C. retorta, Sargassum verruculosum, Jeannerettia lobata, Caulocystis cephalornithos* and *Zonaria ?crenata* occurs on rock substrata on either side of Tinderbox Reach. The underwater habitat for 100 metres east of Tinderbox Bay is composed of sorted boulders of gradually increasing size. Patches of reef devoid of macro-algae within this area probably have been cleared by the grazing activities of dense populations of the sea urchin *Heliocidaris erythrogramma*. Another sea urchin *Goniocidaris tubaria*, the sea star *Tosia magnifica*, the holothurian *Stichopus mollis* and the sponge *Tethya* sp. are prevalent in these cleared patches. It should be noted that smaller numbers of *Heliocidaris* are present throughout the Tinderbox region.

6.1.2 Marine Reserve Recommendation

A marine reserve, extending offshore for a distance of 200 metres, should be declared from Piersons Point to the unnamed point 700 metres south-west of Tinderbox Bay (Fig. 6.1). Handlining for fish should be permitted within the marine reserve, but the taking of organisms by other means, or the destructive interference with the underwater habitat, should be prohibited.

6.1.3 Discussion

The major reason for declaring a marine reserve at Tinderbox is to allow large fish to return to the area, and thus increase the enjoyment of amateur divers (Edgar, 1981). Most aquatic recreational



g 6.1 Boundaries of proposed Tinderbox marine reserve.

activities in the Tinderbox region occur off Tinderbox beach and along the north-eastern shore for a distance of 500 m. This area is protected as the core area within the proposed reserve.

The marine habitats along the shore south-west of Tinderbox Beach were included in the proposal because the underwater physiography is considerably different from the east Tinderbox region, with greater cave and less rock platform development. This area is attractive to divers other than at times when filamentous algae are abundant.

The ecosystems south of Piersons Point were also incorporated in the proposed marine reserve in order to protect moderately exposed habitats. Inclusion of this region was also needed to act as a buffer zone for the protection of the core area.

Restrictions on the capture of rock lobster, abalone and fish should inconvenience few people because legal-sized catches of these species occur rarely at Tinderbox.

6.2 Woodbridge

6.2.1 Underwater habitat

Sheltered conditions prevail throughout the Woodbridge region.

Reef development is very poor with a maximum reef depth of 5 metres occurring 20 metres offshore from Birchs Point. Helliwells Point, and the reef 100 metres north of Woodbridge Jetty, attain maximum depths of only 4 metres before submerging under sand.

The lower eulittoral zone on rocky shores is characterised by bands of *Ulva lactuca* followed by *Hormosira banksii* and then *Cystophora torulosa*. The major sublittoral reef algae, which also occur in other sheltered environments throughout D'Entrecasteaux Channel (Edgar, 1983), are *Caulocystis cephalornithos, Cystophora retroflexa, Sargassum bracteolosum, S. verruculosum* and *Zonaria turneriana*. In shallow, sheltered areas large patches of *Codium fragile* also occur.

The presence of *Acrocarpia paninculata, Carpoglossum confluens, Cystophora moniliformis, Zonaria crenata, Gelidium australe, Seirococcus axillaris, Jeannerettia lobata* and *Ecklonia radiata* at Helliwells and Birchs Points indicates that wave exposure in these areas is greater than in the bay. Minor sea urchin aggregations are present at Helliwells Point.

Shallow sand flats extend for 100 metres from the shoreline into Peppermint Bay. The seafloor then drops gradually to 10 metres depth at a distance of 800 metres from the shore. The soft, benthic substratum consists of large, poorly sorted particles with patches of old scallop shells, and is dominated by benthic animals rather than plants. Bryozoans, sea urchins *(Heliocidaris erythrogramma* and *Goniocidaris tubaria)*, scallops *(Pecten meridionalis* and *Mimachlamys asperrimus)*, pumpkin sponges, sea stars *(Coscinasterias calamarias* and *Uniophora granifera)* and the gorgonian *Mopsea whiteleggei* are widely distributed throughout Peppermint Bay. A green alga *(Codium spongiosum)* and brown alga *(Cystophora grevillea)* are also present on soft substrata. The angiosperm *Halophila ovalis* occurs in shallow water offshore from reefs while *Heterozostera tasmanica* forms patches in the bays. Other interesting habitats in the region include a complex bryozoan reef which is present in 10 metres depth off Helliwells Point and an extensive saltmarsh which has formed on the shore of southern Peppermint Bay at the mouth of Masons Creek.

6.2.2 Marine reserve recommendation

It is not recommended that a marine reserve in Peppermint Bay be proceeded with.

6.2.3 Discussion

A very small marine reserve, with restrictions only on gillnetting and removing intertidal animals within a distance of 250 m of the Marine Studies Centre at Woodbridge, was originally to have been proposed. The major reason for the declaration of a marine reserve would have been to protect the experiments and sampling sites of the Marine Studies Centre, and the intertidal biota which is observed by large numbers of school children. Such items as a glass-

bottom boat could be profitably installed by the Education Department after adequate long term protection was afforded to the reef immediately north of Woodbridge Jetty.

However, local residents have expressed strong opposition to a Peppermint Bay marine reserve. Consequently, it does not now seem worthwhile pursuing the original proposal because the benefit of school children observing as great a biotic diversity as possible would not compensate for the ill-will generated by the declaration of a marine reserve.

6.3 Ninepin Point

6.3.1 Underwater habitat

The marine habitats at Ninepin Point are moderately exposed due to the long southerly fetch down D'Entrecasteaux Channel and the southerly opening to the Tasman Sea.

Ninepin Point Reef lies directly offshore in 7 to 10 metres depth and consists of a large (150 m x 100 m), relatively flat reef dissected by 1 metre high gutters. The reef flora is diverse and composed primarily of red algae. Among the common red algae are *Sonderopelta coriacea, Plocamium angustum, Plocamium potagiatum, Lenormandia marginata* and *Jeannerettia lobata*. The green algae *Caulerpa trifaria* and *Caulerpa sedoides* and the brown algae *Zonaria* spp. and *Taonia australica* are also locally abundant. Sponges and bryozoans also show considerable species diversity with many different growth forms present. The most prominent of the sponges *(Phyllospongia caliciformis)* has a large (15 cm diameter), plate-like form with a green pigmented surface layer of blue-green algae.

Between the shore and the reef are a series of large (up to 2 metre diameter) boulders. The biotic community is dominated by kelps *(Macrocystis pyrifera, Ecklonia radiata* and *Lessonia corrugata)* and *Phyllospora comosa*. The bull-kelp *Durvillaea potatorum* is present in the sublittoral fringe followed by a layer of another brown alga *Xiphophora gladiata*. All of these larger brown algae, other than *Durvillaea* and *Lessonia*, extend along the coast north-east of Ninepin Point. *Cystophora moniliformis, Cystophora retorta, Phloe-*

caulon spectabile, Carpoglossum confluens and *Zonaria* spp. also occur in shallow water in this region.

The cobble beach north-west of Ninepin Point slopes gradually down to a substratum of small boulders followed by rock and then sand. The flora shows characteristics of a sheltered open coastal habitat and consists primarily of *Ulva lactuca, Hormosira banksii, Dictyopteris muelleri, Gigartina crassicaulis, Gigartina ancistroclada, Gigartina mulleriana, Hemineura frondosa, Carpoglossum confluens, Jeannerettia lobata, Zonaria* sp. and *Acrocarpia paniculata*. A slightly more sheltered flora consisting of *Cystophora torulosa, Acrocarpia paniculata, Sargassum verruculosum* and *Hormosira banksii* occurs to the north west of the cobble beach.

6.3.2 Marine Reserve Recommendation

It is recommended that a Nature Reserve be declared at Ninepin Point. This reserve should include the Crown land lying between the Channel Highway and the shoreline as shown in Fig. 6.2, and a marine extension which encompasses the submerged lands within a radius of 500 m from Ninepin Point. The taking of all organisms, or the destructive interference with the underwater habitat, should be prohibited within the boundaries of the marine extension. The radius of the marine extension should be declared relative to a survey mark installed near High Water Mark at Ninepin Point.

6.3.3 Discussion

The conservation significance of Ninepin Point reef was detailed previously (Edgar, 1981). This reef is particularly interesting because red algae and colonial animals typical of the Tasmanian east coast lower sublittoral zone, are present in water of 8 m depth rather than in depths greater than 20 m. This is probably due to tannins in the surface water during winter which greatly reduce light penetration (Edgar, 1984). After an unusually dry winter in 1983, the sustained high levels of light which reached the reef bleached many of the red algae.

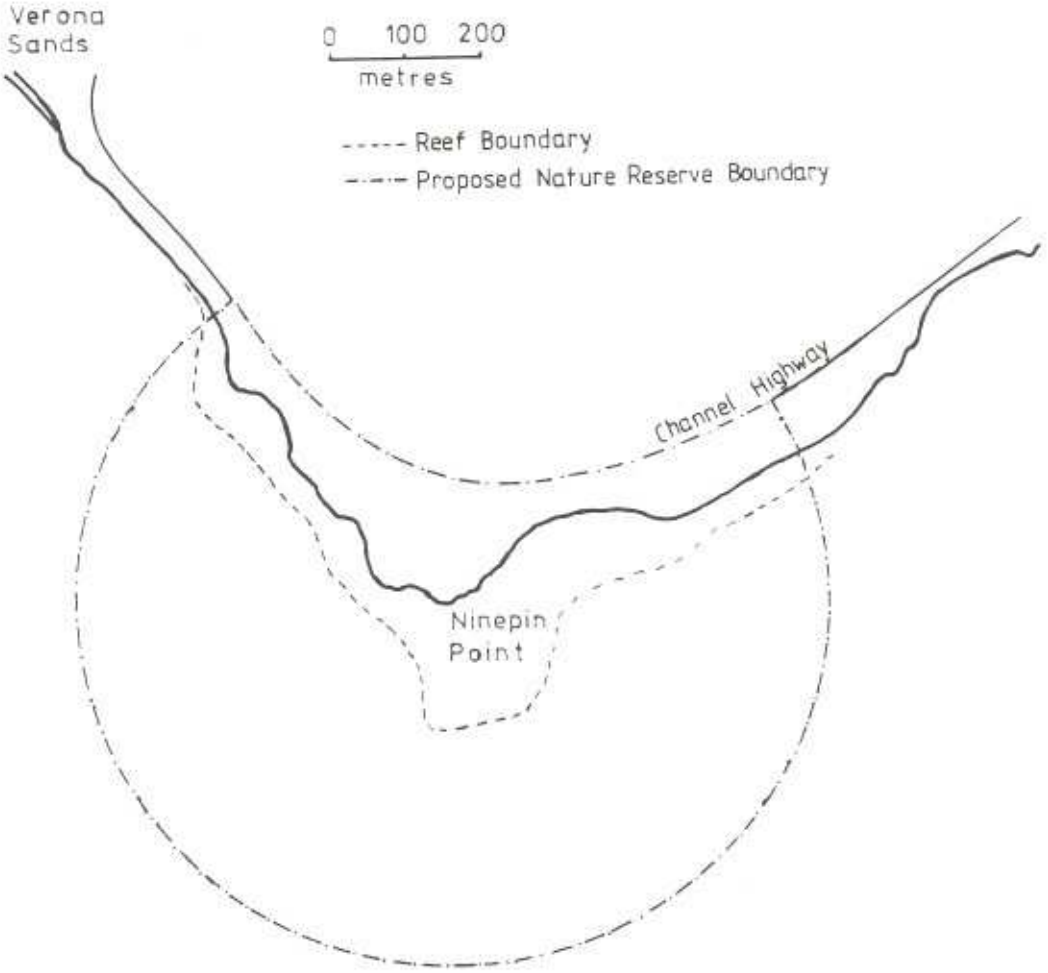


Fig 6.2 Boundaries of proposed Ninepin Point Nature Reserve.

It is important that a Ninepin Point marine reserve be declared as soon as possible because the diversity and abundance of fish at this site have only recently been recognised by divers (including spearfishermen) and net fishermen. The area has been heavil exploited since then. No fishing should be allowed within this rese as even handlining would remove the larger fish species (e.g. *Nemadactylus macropterus*, *Eubalichthys gunnii* and *Neosebastes scorpaenoides*) which contribute to the interest of the area. Fisherm should not be greatly inconvenienced by the declaration of a reserve because of its small size and the presence of other reefs north of Ninepin Point, south of Verona Sands and off Huon Island.

7. CONCLUSIONS

The proposed Kent Group marine reserve plus the marine extensions to the Maria Island and Rocky Cape National Parks which were recommended in the 1981 report comprise the major elements of a proposed integrated Tasmanian marine reserve system. The three major proposed marine reserves all include both sheltered and exposed habitats. They also each represent, and are the obvious selection from, each of the different biogeographic regions of Tasmania. The marine biota in the Kent Group is largely from the Peronian (New South Wales) biogeographic province, the Rocky Cape biota from the Flindersian (southern Australian) province, and the Maria Island biota from the Maugean (southern Tasmanian) province. Between them the three proposed reserves encompass most of Tasmania's inshore marine communities. Additional conservation reserves nevertheless will be needed to protect small areas of scientifically interesting habitat and those habitats not included in the three regional reserves.

Examples of such habitats are the shallow, low light reefs of Ninepin Point and Bathurst Channel, and those Furneaux Group rocky reefs which are typified by the fishes *Meuschenia flavolineata* and *Meuschenia hippocrepis*. King Island may also contain different or unusual marine habitats but is yet to be investigated.

The minimum viable size for marine reserves is still to be determined, both in Tasmania and elsewhere in the world, however sustainable populations of algae, invertebrates and sedentary reef fishes (such as wrasse, leatherjackets, rock whiting and cave dwelling species) would probably survive on relatively small reefs. Less territorial fishes such as trumpeter, morwong, silverbelly, red mullet and butterfly perch would be much less likely to occur in large numbers in small marine reserves with heavily exploited environs. Moreover, pelagic fishes such as mackerel, trevally and sea pike would not be contained within marine parks of any size.

Because of a reduction in the abundances of some fish species on small reefs, the recommended Governor Island, Ninepin Point and Tinderbox marine reserves would have less conservation significance than the larger marine reserves, however this would be compensated

by their greater recreational value. Small marine reserves near population centres in other States, such as Port Noarlunga and Aldinga in South Australia, Pope's Eye in Victoria, and Shiprock in New South Wales, are all highly regarded and have become extremely popular with divers.

All six proposed Tasmanian marine reserves would ideally be declared immediately, however this is unlikely to be achieved. The proposed marine reserve in most urgent need of declaration is Rocky Cape. However it is also the only one whose declaration could cause hardship to a section of the public. Some of the residents and shack-owners at Rocky Cape and Sisters Beach, and to a lesser extent Boat Harbour, may be inconvenienced by the declaration of a marine reserve because those who set nets will need to travel offshore (past the 1 km mark) or along the coast. Unfortunately, this potential conflict between net fishermen and the reserve seems irreconcilable because there is no practical alternative to the Rocky Cape proposal if a representative section of the Bass Strait ecosystem is to be preserved. The Rocky Cape National Park contains the only large and accessible section of rocky shore along the northern Tasmanian coast which is relatively free from pollution.

The inconvenience to fishermen caused by the declaration of the other five marine reserves is negligible. Fishermen should have no difficulty bypassing the three recreational reserves and setting gear in adjacent areas because of the very limited size of these reserves. Similarly, because only National Parks and Wildlife Service staff live at Maria Island, fishermen should be able to take their boats to other areas along the east Tasmanian coast to set nets, or place them along the southern or eastern shores of Maria Island which are outside the protected area. Furthermore, no private residents live in the Kent Group, and the islands are distant from population centres. Professional fishermen should not be greatly troubled because they can still take rock lobster and abalone.

Thus, the Rocky Cape marine habitats are most in need of protection because of the pollution common to most of the north-western coast and because of the increasing fishing pressure. However, it would probably be more acceptable to the public to proclaim the Governor Island and Kent Group marine reserves first. These reserves

should then be followed by the Rocky Cape, Maria Island and Ninepin Point marine reserves. There is no urgency to declare a marine reserve at Tinderbox because this area has been over-fished throughout the past decade. It is unlikely that this environment will be further degraded in the near future.

The only significant cost to the public in setting up these marine reserves, apart from the restriction on gill-netting and spear-fishing along c. 2% of the Tasmanian coast, is the expense of constructing signposts and placing these on the foreshores near the reserves. The signposts will need to define the boundaries of the marine reserves and whatever special fishing regulations apply. The policing of the marine reserves is expected to entail minimal additional expense. The restrictions on fishing would be largely self-regulated by the public, as occurs in other States. Tasmanian Fisheries Development Authority inspectors could be notified whenever blatant abuse of the regulations occur. The larger proposed marine reserves can be policed by local National Parks and Wildlife Service and Tasmanian Fisheries Development Authority officers as part of their normal duties, with assistance from the Deal Island light-house keepers in the Kent Group region.

Prior to the declaration of any Tasmanian marine reserve, a localised, quantitative survey of aquatic plants and animals should be conducted. Any changes in the biotic community caused by fishing regulations, such as an increase in fish, abalone or rock lobster populations, could then be assessed. It is possible that an increased abundance of large fish, abalone or rock lobsters could cause secondary effects which should also be monitored. In the Tinderbox region, for example, the increased predation of fish on sea urchins in a marine reserve could disperse the urchin aggregations, resulting in a regrowth of algae. Alternatively, increased numbers of abalone could exert greater grazing pressure on algae, resulting in less algal biomass and more open space.

One additional general survey of Tasmanian marine life needs to be undertaken in the King Island region. This region, and the Tasmanian west coast, are the only major areas of Tasmania yet to be investigated. A survey of west coast marine habitats is of lower priority than a survey of King Island because the rough seas and extensive beaches make it unlikely that a marine reserve will be declared between Low Rocky Point and Cape Grim.

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APPENDIX 1: FISHES RECORDED FROM THE KENT GROUP

	Author[1]	Sites[2]
Port Jackson shark, *Heterodontus portusjacksoni* (Meyer)	1	6
Rusty catshark, *Parascyllium ferruginium* McCulloch		3
Draughtboard shark, *Cephaloscyllium laticeps* (Dumeril)	1	2,6
Angel shark, *Squatina australis* Regan	1	
Banks shovelnose ray, *Aptychotrema rostrata* Shaw & Nodder	1	
Smooth stingray, *Dasyatis brevicaudatus* (Hutton)	1	
Spotted stingaree, *Urolophus gigas* Scott	2	
Eagle ray, *Myliobatis australis* Macleay	1	
Blue sprat, *Spratelloides robustus* Ogilby	2	3
Conger eel, *Conger verreauxi* Kaup	2	
Sergeant Baker, *Latropiscus purpurissatus* (Richardson)	1	
Beardie, *Lotella rhacinus* (Bloch & Schneider)		3
Bearded rock cod, *Pseudophycis barbatus* (Günther)	1	
Small-mouthed hardyhead, *Atherinasoma ?microstoma* (Günther)	1	
Silverfish, *Atherinasoma presbyteroides* (Richardson)	2	2,3
Hardyhead, *Atherinasoma* sp.	1	
Ogilbys hardyhead, *Pranesis ogilbyi* Whitley	1	
Red-banded shore eel, *Alabes rufus* (Macleay)	2	
Red gurnard perch, *Helicolenus papillosus* (Bloch & Schneider)	1	
Common gurnard perch, *Neosebastes scorpaenoides* Guichenot	1	
Common red rock cod, *Scorpaena ergastulorum* Richardson	1	3
Warty prowfish, *Aetapcus maculatus* (Günther)	2	
Toothy flathead, *Platycephalus* sp.	1	
Sea moth, *Acanthopegasus lancifer* (Kaup)	1	
Butterfly perch, *Caesioperca lepidoptera* (Bloch & Schneider)	1,2	1,2,3,4,5
Barber perch, *Caesioperca rasor* (Richardson)	1,2	1,2,3,4,5
Half-banded sea perch, *Ellerkeldia maccullochi* Whitley	1	1,3
Blotch-tailed trachinops, *Trachinops caudimaculatus* McCoy	1,2	1,2,3,4,5
Long-finned pike, *Dinolestes lewini* (Griffith)	1,2	1,3,4,6
Southern cardinal fish, *Vincentia conspersa* Klunzinger	1	3,6
Silver trevally, *Caranx georgianus* Cuvier & Valenciennes	2	
Australian salmon, *Arripis trutta* (Bloch & Schneider)	2	

Silverbelly, *Parequula melbournensis* (Castelnau)	1,2	2,3,6
Red mullet, *Upeneichthys vlamingii* (Cuvier & Valenciennes)	1,2	2,3,5,6
Common bullseye, *Pempheris multiradiatus* Klunzinger	1,2	1,2,3,5,6
Black drummer, *Girella elevata* Macleay	1,2	
Luderick, *Girella tricuspidata* (Quoy & Gaimard)	2	
Silver drummer, *Kyphosus sydneyanus* (Günther)	2	
Zebra fish, *Melambaphes zebra* (Richardson)	1,2	2,3,5
Sea sweep, *Scorpis aequipinnis* Richardson	1,2	1,3,4,5,6
Sweep, *Scorpis lineolatus* Kner	2	1,3
Mado, *Atypichthys strigatus* (Günther)	1,2	3
Old wife, *Enoplosus armatus* (White)	1,2	3
Long-snouted boarfish, *Pentaceropsis recurvirostris* (Richardson)	1,2	
One-spot puller, *Chromis hypsilepis* (Günther)	1,2	3
White ear, *Parma microlepis* Günther	1,2	2,3,5,6
Scalyfin, *Parma victoriae* (Günther)		2
Sea carp, *Dactylosargus arctidens* (Richardson)	1,2	1,2,3,4,5
Magpie perch, *Cheilodactylus nigripes* Richardson	1,2	1,2,3,5
Banded morwong, *Cheilodactylus spectabile* (Klunzinger)	1,2	1,3,5
Dusky morwong, *Dactylophora nigricans* (Macleay)		2
Jackass morwong, *Nemadactylus macropterus* (Bloch & Schneider)	1	
Bastard trumpeter, *Latridopsis forsteri* (Castelnau)	1,2	1,2,3,6
Yellow-eyed mullet, *Aldrichetta forsteri* (Cuvier & Valenciennes)	2	
Snook, *Sphyraena novaehollandiae* (Günther)	2	
Castelnaus Wrasse, *Dotalabrus aurantiacus* (Castelnau)	1	3
Maori wrasse, *Ophthalmolepis cyanogramma* (Richardson)	1	1,3
Senator fish, *Pictilabrus laticlavius* (Richardson)	1,2	1,2,3,5,6
Purple wrasse, *Pseudolabrus fucicola* (Richardson)	1,2	1,2,3,4,5
Rosy wrasse, *Pseudolabrus psittaculus* (Richardson)	1,2	1,2,3,4,5
Blue-throated wrasse, *Pseudolabrus tetricus* (Richardson)	1,2	1,2,3,4,5
Snakeskin wrasse, *Eupetrichthys angustipes* Ramsay & Ogilby	1	
Rainbow fish, *Heteroscarus acroptilus* (Richardson)	1	3
Slender rock whiting, *Neoodax attenuatus* (Ogilby)	1	
Little rock whiting, *Neoodax balteatus* (Cuvier & Valenciennes)	2	
Pencil rock whiting, *Neoodax beddomei* (Johnston)	1	3
Herring cale, *Olisthops cyanomelas* Richardson	1,2	1,2,3,5
Sandfish, *Crapatalus* sp.	2	

Dragonet, *Bovichthys variegatus* (Richardson)		5
Macleays threefin, *Norfolkia striaticeps*	1,2	3
Rock threefin, *Norfolkia* sp.	1	
Johnstons weedfish, *Heteroclinus johnstoni* (Saville-Kent)	1	
Wilsons weedfish, *Heteroclinus wilsoni* (Lucas)	1	
Weedfish, *Heteroclinus* sp.	1	
Tasmanian blenny, *Pictiblennius tasmanianus* (Richardson)	2	
Sculptured goby, *Callogobius mucosus* (Günther)	1	
Sand goby, *Nesogobius* sp. 1	1	3
Sand goby, *Nesogobius* sp. 2	1	
Trevalla, *Seriolella* sp.	2	2
Spotted flounder, *Ammotretis liturata* (Richardson)	2	
Pigmy leatherjacket, *Brachaluteres jacksonianus* (Quoy & Gaimard)	1	
Velvet leatherjacket, *Eubalichthys gunnii* (Günther)	1,2	3
Mosaic leatherjacket, *Eubalichthys mosaicus* (Ramsay & Ogilby)	1	
Brown-striped leatherjacket, *Meuschenia australis* (Donovan)	1,2	
Six-spined leatherjacket, *Meuschenia freycineti* (Quoy & Gaimard)	1,2	3
Horseshoe leatherjacket, *Meuschenia hippocrepis* (Quoy & Gaimard)	1	
Cosmopolitan leatherjacket, *Parika scaber* (Günther)	1	1,3
Toothbrush leatherjacket, *Penicipelta vittiger* (Castelnau)	1,2	1,2,3,5
Rough leatherjacket, *Scobinichthys granulatus* (Shaw)	1	
Shaws cowfish, *Aracana aurita* (Shaw)	1,2	
Porcupine fish, *Diodon nicthemerus* Cuvier	1,2	1,2,3,5

1. Author 1 : R. Kuiter (1981)
   Author 2 : P. Last (1979)

2. The sites, as listed in Table 3.1, where the species were recorded during the present survey.

APPENDIX 2: FISHES RECORDED FROM SOUTH WEST TASMANIA

Fishes collected within the Port Davey region. Authorities for species not recorded during the present survey are unpublished check-lists of the region compiled by Barry Hutchins (1) and Peter Last (2), and a paper by Johnston (1882) (3).

Common Name	Scientific Name	Reference
Port Jackson Shark	*Heterodontus portusjacksoni* (Meyer)	1
Rusty Catshark	*Parascyllium ferrugineum* McCulloch	
White-spotted Dogfish	*Squalus acanthias* Linnaeus	
Banded Stingaree	*Urolophus cruciatus* (Lacepede)	
Elephant Shark	*Callorhynchus milii* Bory de St Vincent	
Conger Eel	*Conger verreauxi* Kaup	1
Southern Eel	*Anguilla australis* Richardson	
Southern Worm Eel	*Muraenichthys breviceps* Günther	1
Tasmanian Smelt	*Retropinna tasmanica* McCulloch	2
Common Jollytail	*Galaxias maculatus* (Jenyns)	2
Red Cod	*Pseudophycis bachus* (Bloch & Schneider)	
Bearded Rock Cod	*Pseudophycis barbatus* Günther	
Blue Grenadier	*Macruronus novaezelandiae* (Hector)	3
Small-mouthed Hardy-head	*Atherinosoma microstoma* Günther	2
Silverfish	*Atherinosoma presbyteroides* (Richardson)	
Sandpaper Fish	*Paratrachichthys trailli* (Hutton)	
Half-banded Pipefish	*Leptonotus semistriatus* Kaup	2
Spotted Pipefish	*Stigmatopora argus* (Richardson)	2
Saw-toothed Pipefish	*Maroubra perserrata* Whitley	1
Big-bellied Seahorse	*Hippocampus abdominalis* Lesson	
Soldier Fish	*Gymnapistes marmoratus* (Cuvier & Valenciennes)	2
Red Gurnard Perch	*Helicolenus papillosus* (Bloch & Schneider)	
Red Rock Cod	*Scorpaena ergastulorum* Richardson	
Common Gurnard Perch	*Neosebastes scorpaenoides* Guichenot	
Sand Flathead	*Platycephalus bassensis* Cuvier & Valenciennes	
Barber Perch	*Caesioperca rasor* (Richardson)	
Trachinops	*Trachinops caudimaculatus* McCoy	

Southern Cardinal Fish	*Vincentia conspersa* (Klunzinger)	
Long-finned Pike	*Dinolestes lewini* (Griffith)	
Jack Mackerel	*Trachurus declivis* (Jenyns)	2
Australian Salmon	*Arripis trutta* (Bloch & Schneider)	2
Common Bullseye	*Pempheris multiradiata* Klunzinger	
Sea Carp	*Dactylosargus arctidens* (Richardson)	
Magpie Perch	*Cheilodactylus nigripes* Richardson	1
Banded Morwong	*Cheilodactylus spectabile* (Hutton)	
Morwong	*Nemadactylus macropterus* (Bloch & Schneider)	
Bastard Trumpeter	*Latridopsis forsteri* (Castelnau)	
Striped Trumpeter	*Latris lineata* (Bloch & Schneider)	
Yellow-eyed Mullet	*Aldrichetta forsteri* (Cuvier & Valenciennes)	2
Senator Fish	*Pictilabrus laticlavius* (Richardson)	
Purple Wrasse	*Pseudolabrus fucicola* (Richardson)	
Rosy Wrasse	*Pseudolabrus psittaculus* (Richardson)	
Blue-throated Wrasse	*Pseudolabrus tetricus* (Richardson)	
Little Rock Whiting	*Neoodax balteatus* (Cuvier & Valenciennes)	
Stargazer	*Kathetostoma laeve* (Bloch & Schneider)	2
Common Sandfish	*Crapatalus arenarius* McCulloch	2
Dragonet	*Bovichthys variegatus* (Richardson)	
Congolli	*Pseudophritis urvillii* (Cuvier & Valenciennes)	2
Macleay's Threefin	*Norfolkia striaticeps* Ramsay & Ogilby	
Crested Weedfish	*Cristiceps australis* Cuvier & Valenciennes	2
Ogilby's Weedfish	*Heteroclinus heptaeolus* (Ogilby)	1
Johnston's Weedfish	*Heteroclinus johnstoni* (Saville-Kent)	1
Common Weedfish	*Heteroclinus perspicillatus* (Cuvier & Valenciennes)	
Wilson's Weedfish	*Heteroclinus wilsoni* (Lucas)	1
Black Snake Blenny	*Ophiclinus gracilis* Waite	1
Tasmanian Blenny	*Pictiblennius tasmanianus* (Richardson)	
Sculptured Goby	*Callogobius mucosus* Günther	1
Orange-spotted Goby	*Nesogobius hindsbyi* (McCulloch & Ogilby)	
Castelnau's Goby	*Nesogobius pulchellus* (Castelnau)	
Tamar Goby	*Favonigobius tamarensis* (Johnston)	
Shore Eel	*Alabes dorsalis* (Richardson)	1

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Fishes collected within the Port Davey region. Authorities for species not recorded during the present survey are unpublished check-lists of the region compiled by Barry Hutchins (1) and Peter Last (2) and a paper by Johnston (1882) (3).

Common Name	Scientific Name	Referenc
Port Jackson Shark	*Heterodontus portusjacksoni* (Meyer)	1
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White-spotted Dogfish	*Squalus acanthias* Linnaeus	
Banded Stingaree	*Urolophus cruciatus* (Lacepede)	
Elephant Shark	*Callorhynchus milii* Bory de St Vincent	
Conger Eel	*Conger verreauxi* Kaup	1
Southern Eel	*Anguilla australis* Richardson	
Southern Worm Eel	*Muraenichthys breviceps* Günther	1
Tasmanian Smelt	*Retropinna tasmanica* McCulloch	2
Common Jollytail	*Galaxias maculatus* (Jenyns)	2
Red Cod	*Pseudophycis bachus* (Bloch & Schneider)	
Bearded Rock Cod	*Pseudophycis barbatus* Günther	
Blue Grenadier	*Macruronus novaezelandiae* (Hector)	3
Small-mouthed Hardy-head	*Atherinosoma microstoma* Günther	2
Silverfish	*Atherinosoma presbyteroides* (Richardson)	
Sandpaper Fish	*Paratrachichthys trailli* (Hutton)	
Half-banded Pipefish	*Leptonotus semistriatus* Kaup	2
Spotted Pipefish	*Stigmatopora argus* (Richardson)	2
Saw-toothed Pipefish	*Maroubra perserrata* Whitley	1
Big-bellied Seahorse	*Hippocampus abdominalis* Lesson	
Soldier Fish	*Gymnapistes marmoratus* (Cuvier & Valenciennes)	2
Red Gurnard Perch	*Helicolenus papillosus* (Bloch & Schneider)	
Red Rock Cod	*Scorpaena ergastulorum* Richardson	
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Sand Flathead	*Platycephalus bassensis* Cuvier & Valenciennes	
Barber Perch	*Caesioperca rasor* (Richardson)	
Trachinops	*Trachinops caudimaculatus* McCoy	

Southern Cardinal Fish	*Vincentia conspersa* (Klunzinger)	
Long-finned Pike	*Dinolestes lewini* (Griffith)	
Jack Mackerel	*Trachurus declivis* (Jenyns)	2
Australian Salmon	*Arripis trutta* (Bloch & Schneider)	2
Common Bullseye	*Pempheris multiradiata* Klunzinger	
Sea Carp	*Dactylosargus arctidens* (Richardson)	
Magpie Perch	*Cheilodactylus nigripes* Richardson	1
Banded Morwong	*Cheilodactylus spectabile* (Hutton)	
Morwong	*Nemadactylus macropterus* (Bloch & Schneider)	
Bastard Trumpeter	*Latridopsis forsteri* (Castelnau)	
Striped Trumpeter	*Latris lineata* (Bloch & Schneider)	
Yellow-eyed Mullet	*Aldrichetta forsteri* (Cuvier & Valenciennes)	2
Senator Fish	*Pictilabrus laticlavius* (Richardson)	
Purple Wrasse	*Pseudolabrus fucicola* (Richardson)	
Rosy Wrasse	*Pseudolabrus psittaculus* (Richardson)	
Blue-throated Wrasse	*Pseudolabrus tetricus* (Richardson)	
Little Rock Whiting	*Neoodax balteatus* (Cuvier & Valenciennes)	
Stargazer	*Kathetostoma laeve* (Bloch & Schneider)	2
Common Sandfish	*Crapatalus arenarius* McCulloch	2
Dragonet	*Bovichthys variegatus* (Richardson)	
Congolli	*Pseudophritis urvillii* (Cuvier & Valenciennes)	2
Macleay's Threefin	*Norfolkia striaticeps* Ramsay & Ogilby	
Crested Weedfish	*Cristiceps australis* Cuvier & Valenciennes	2
Ogilby's Weedfish	*Heteroclinus heptaeolus* (Ogilby)	1
Johnston's Weedfish	*Heteroclinus johnstoni* (Saville-Kent)	1
Common Weedfish	*Heteroclinus perspicillatus* (Cuvier & Valenciennes)	
Wilson's Weedfish	*Heteroclinus wilsoni* (Lucas)	1
Black Snake Blenny	*Ophiclinus gracilis* Waite	1
Tasmanian Blenny	*Pictiblennius tasmanianus* (Richardson)	
Sculptured Goby	*Callogobius mucosus* Günther	1
Orange-spotted Goby	*Nesogobius hindsbyi* (McCulloch & Ogilby)	
Castelnau's Goby	*Nesogobius pulchellus* (Castelnau)	
Tamar Goby	*Favonigobius tamarensis* (Johnston)	
Shore Eel	*Alabes dorsalis* (Richardson)	1

Spotted Flounder	*Ammotretis liturata* (Richardson)	2
Long-snouted Flounder	*Ammotretis rostratus* " Gunther	2
Greenback Flounder	*Rhombosolea tapirina* " Gunther	
Bridled Leatherjacket	*Acanthaluteres spilomelanurus* (Quoy & Gaimard)	
Brown-striped Leather-jacket	*Meuschenia australis* (Donovan)	
Toothbrush Leather-jacket	*Penicipelta vittiger* (Castelnau)	
Shaw's Cowfish	*Aracana aurita* (Shaw)	
Smooth Toadfish	*Torquigener glaber* (Freminville)	
Porcupine Fish	*Diodon nicthemerus* Cuvier	

Fishes recorded along the southern coast but not in Port Davey. Species referred to authority 4 are listed by Hynd & Robins (1967).

Butterfly Perch	*Caesioperca lepidoptera* (Bloch & Schneider)	
Sea Sweep	*Scorpis aequipinnis* Richardson	
Real Bastard Trumpeter	*Mendesoma allporti* Johnston	
Barracouta	*Thyrsites atun* (Euphrasen)	
Skipjack Tuna	*Katsuwonis pelamis* (Linnaeus)	4
Southern Bluefin Tuna	*Thunnus maccoyii* (Castelnau)	4
Cardinal Clingfish	*Creocele cardinalis* (Ramsay)	

APPENDIX 3 : INVERTEBRATES RECORDED FROM SOUTH WEST TASMANIA

Marine invertebrate species recorded from inshore South West Tasmanian waters. All species were recorded during the present survey other than those marked #4 (recorded by Guiler, 1954), #5 (Tenison-Woods, 1875), #6 (Brazier, 1886), #7 (Dartnall, 1970) and #8 (Thomson, 1978a).

CNIDARIA

Solanderia fusca (Grey)
Corynactis australis Haddon & Duerden
Actinia tenebrosa Farquhar
Oulactis muscosa Dana
Anthothoe albocincta (Stuckey)
Cnidopus verater (Drayton)
Phlyctenanthus australis Carlgren
Balanophyllia bairdiana Edwards & Haime
Capnella erecta Verseveldt
Mopsea whiteleggei Thomson & Mackinnon
Mopsea encrinula (Lamarck)
Primnoella australasiae Gray
Sarcoptilis grandis (Gray)
Acabaria gracillima Ridley

POLYCHAETA

Galeolaria caespitosa (Savigny)

MOLLUSCA

Callochiton crocinus (Reeve)
Poneroplax costata (Blainville)
Sypharochiton pelliserpentis Quoy & Gaimard
Cryptoplax striata (Lamarck)
Ischnochiton mawlei Iredale & May
Ischnochiton variegatus (Adams & Angas)
Ischnochiton cariosa Pilsbry
Ischnochiton subviridis (Iredale & May)

MOLLUSCA (cont)

Brachidontes rostratus (Dunker)

Xenostrobus pulex (Lamarck)

Xenostrobus securis (Lamarck)

Mytilus edulis planulatus (Lamarck)

Pecten meridionalis Tate

Kellia australis (Lamarck)

Homalina mariae #5

Electroma georgiana #8

Donacilla erycinaea #8

Katelysia rhytiphora #8

Phacosoma coerulea #8

Homalina deltoidalis #8

Pseudarocopagia botanica #8

Solatellina biradiata #8

Neotrigonia margaritacea #8

Fulvia tenuicostata #8

Ostrea angasi #8

Irus grisea (Lamarck)

Lissarca rubricata (Tate)

Halliotis ruber Leach

Notoacmaea mayi May

Notoacmaea flammea (Quoy & Gaimard)

Patelloida victoriana (Singleton)

Patelloida latistrigata (Angas)

Patelloid alticostata (Angas)

Patelloida insignis (Menke)

Patelloida marmorata #4

Patellanax peroni (Blainville)

Patellanax chapmani alba (Tenison-Woods)

Austrocochlea odontis #6

Austrocochlea constricta (Lamarck)

Cellana solida (Blainville)

Pisinna circumlabra Ponder & Yoo

Zalipais inscripta (Tate)

Eatoniella melanochroma (Tate)

Eatoniella fulva Ponder & Yoo

Cymatiella lesueuri Iredale

MOLLUSCA (cont)

Pleurobranchus maculatus Quoy & Gain

Clanculus plebejus (Philippi)

Phasianotrochus eximinius (Perry)

Notomella candida (Adams)

Charonia rubicunda (Perry)

Deviginella ringens (May)

Sinuginella ?pygmaeoides (Singleton)

Dentimitrella semiconvexa (Lamarck)

Dentimitrella pulla (Gaskoin)

Macrozafra fulgida (Reeve)

Propefusus pyrulatus (Reeve)

Pleuroploca australasia #8

Argobuccinium vexillum (Sowerby)

?Nanula galbina Hedley & May

Tolema australis (Laseron)

Minopa petterdi (Crosse)

Turbo undulatus Solander

Cantharidella tiberiana (Crosse)

Micrastraea aurea (Jonas)

Calliostoma hedleyi #4

Bembicium auratum (Quoy & Gaimard)

Cominella lineolata (Lamarck)

Lepsiella vinosa (Lamarck)

Thais baileyana (Tenison-Woods)

Thais textilosa #8

Nerita melanotragus Smith

Siphonaria tasmanica Tenison-Woods

Sophonaria diemenensis Quoy & Gaimard

Littorina praetermissa (May)

Littorina unifasciata (Gray)

CRUSTACEA

Tetraclitella purpurascens Wood

Catomerus polymerus (Darwin)

Chamaesipho columna (Spengler)

Chthamalus antennatus #4

Elminius modestus (Darwin)

Epopomella simplex (Darwin)

Ligia australiensis Dana

CRUSTACEA (cont)

Macrobrachium intermedium Stimpson

Cyclograpsus granulosus (Milne-Edwards)

Paragrapsus gaimardii (Milne-Edwards)

Paragrapsus quadridentatus (Milne-Edwards)

Lomis hirta (Lamarck)

Naxia aurita (Latreille)

Plagusia chabrus (Linnaeus)

Leptograpsus variegatus (Fabricius)

Nectocarcinus tuberculosus Milne-Edwards

Halicarcinus ovatus (Stimpson)

Pseudocarcinus gigas (Lamarck)

Jasus novaehollandiae Holthuis

ECHINODERMATA

Ophiactis resiliens Lyman

Ophiactis symbiota Clark

Ophionereis schayeri (Müller & Troschel)

Clarkoma caniculata (Lutken)

Conocladus australis (Verrill)

Comanthus trichoptera (Müller)

Patiriella calcar (Lamarck)

Patiriella exigua (Lamarck)

Patiriella gunni (Gray)

Tosia magnifica (Müller & Troschel)

Astrostole scabra (Hutton)

Petricia vernicina (Lamarck)

Austrofromia polypora (Clark)

Nectria ocellata Perrier

Asterina scobinata #7

Goniocidaris tubaria Koehler

Echinocardium cordatum (Pennant)

ASCIDEACEA

Pyura stolonifera (Heller)

Pyura tasmanensis Kott

Synoicum papilliferum (Michaelson)

Sycozoa cerebriforme (Quoy & Gaimard)

ASCIDEACEA (cont)

Ascidia sydneyensis Stimpson
Phallusia depressiuscula (Heller)
Cnemidocarpa etheridgii (Herdman)
Polycarpa rigida Herdman
Botrylloides magnicoecus (Michaelson & Hartmeyer)
Microcosmus stoloniferus Kott

APPENDIX 4 : MARINE PLANTS RECORDED FROM SOUTH WEST TASMANIA

Plant species recorded during the present survey.

SPERMATOPHYCEAE

Heterozostera tasmanica (Martens ex Asch.) Hartog

RHODOPHYCEAE

Lithophyllum hyperellum Fosli
Hypnea episcopalis Hook. & Harv.
Gigartina ancistroclada Mont.
Gigartina gigantea Mont.
Plocamium angustum (J. Ag.) Hook. & Harv.
Plocamium mertensii (Grev.) Harv.
Melanthalia obtusata (Labill.) J. Ag.
Hemineura frondosa Harv.
Thamnoclonium clariferum J. Ag.
Sonderopelta coriacea Wom. & Sinkora
Jeannerettia lobata Hook. & Harv.
Phacelocarpus labillardieri (Mert.) J. Ag.
Callophyllis rangiferinus (Turn.) Wom.
Lenormandia muelleri Sonder
Delisea pulchra (Grev.) Mont.
Ballia callitricha (Ag.) Mont.

CHLOROPHYCEAE

Enteromorpha intestinalis Link.
Codium fragile (J. Ag.) Silva
Codium pomoides J. Ag.
Chaetomorpha darwinii (Hook.) Kuetz.
Caulerpa brownii (C. Ag.) Endl.
Caulerpa geminata Harv.
Caulerpa trifaria Harv.
Caulerpa flexilis Lamaroux

PHAEOPHYCEAE

Hormosira banksii (Turn.) Descaisne
Xiphophora gladiata (Labill.) Mont. ex Kjell.
Durvillaea potatorum (Labill.) Aresch.

PHAEOPHYCEAE (cont)

Macrocystis pyrifera (L.) C. Ag.

Phyllospora comosa C. Ag.

Ecklonia radiata (C. Ag.) J. Ag.

Lessonia corrugata Lucas

Cystophora xiphocarpa Harv.

Cystophora platylobium (Mert.) J. Ag.

Cystophora retorta (Mert.) J. Ag.

Cystophora moniliformis (Esper) Wom. & N

Cystophora siliquosa J. Ag.

Cystophora subfarcinata (Mert.) J. Ag.

Dictyopteris muelleri (Sonder) Reinbold

Carpoglossum confluens (R. Br. ex Turn.)

Zonaria turneriana J. Ag.

Phloecaulon spectabile Reinke

Scytosiphon lomentaria (Lyngbye) Link.

Sargassum verruculosum (Mert.) J. Ag.

APPENDIX 5: FISHES RECORDED FROM THE BICHENO REGION

Common Name	Scientific Name
Draughtboard Shark	*Cephaloscyllium laticeps* (Dumeril)
Banded Stingaree	*Urolophus cruciatus* (Lacepede)
Spotted Stingaree	*Urolophus paucimaculatus* Dixon
Conger Eel	*Conger verreauxi* Kaup
Beardie	*Lotella rhacinus* (Forster)
Bearded Rock Cod	*Pseudophycis barbatus* (Günther)
Red Cod	*Pseudophycis bachus* (Bloch & Schneider)
Dannevig's Hardyhead	*Atherinason hepsetoides* (Richardson)
Sandpaper Fish	*Paratrachichthys trailli* (Hutton)
Wide-bodied Pipefish	*Stigmatopora nigra* Kaup
Big-bellied Seahorse	*Hippocampus abdominalis* Lesson
Butterfly Gurnard	*Lepidotrigla vanessa* (Richardson)
Red Velvet Fish	*Gnathanacanthus goetzeei* Bleeker
Red Rock Cod	*Scorpaena ergastulorum* Richardson
Common Gurnard Perch	*Neosebastes scorpaenoides* Guichenot
Red Gurnard Perch	*Helicolenus papillosus* (Bloch & Schneider)
Tiger Flathead	*Platycephalus richardsoni* Castelnau
Sand Flathead	*Platycephalus bassensis* Cuvier & Valenciennes
Butterfly Perch	*Caesioperca lepidoptera* (Bloch & Schneider)
Half-banded Sea Perch	*Ellerkeldia maccullochi* Whitley
Trachinops	*Trachinops caudimaculatus* McCoy
Southern Cardinal Fish	*Vincentia conspersa* (Klunzinger)
Long-finned Pike	*Dinolestes lewini* (Griffith)
Jack Mackerel	*Trachurus declivis* (Jenyns)
Warehou	*Pseudocaranx dentex* Bloch & Sscheider
Silverbelly	*Pareguula melbournensis* (Castelnau)
Red Mullet	*Upeneichthys vlamingii* (Cuvier & Valenciennes)
Common Bullseye	*Pempheris multiradiatus* Klunzinger
Rock Blackfish	*Girella elevata* Macleay
Zebrafish	*Melambaphes zebra* (Richardson)
Mado	*Atypichthys strigatus* (Günther)
Sweep	*Scorpis lineolatus* Kner
Boarfish	*Pentaceropsis recurvirostris* (Richardson)
White Ear	*Parma microlepis* Günther
Sea Carp	*Dactylosargus arctidens* (Richardson)

Morwong	*Nemadactylus macropteris* (Bloch & Schneider)
Banded Morwong	*Cheilodactylus spectabile* (Hutton)
Bastard Trumpeter	*Latridopsis forsteri* (Castelnau)
Senator Fish	*Pictilabrus laticlavius* (Richardson)
Purple Wrasse	*Pseudolabrus fucicola* (Richardson)
Rosy Wrasse	*Pseudolabrus psittaculus* (Richardson)
Blue-throated Wrasse	*Pseudolabrus tetricus* (Richardson)
Little Rock Whiting	*Neoodax balteatus* (Cuvier & Valenciennes)
Herring Cale	*Odax cyanomelas* Richardson
Slender Rock Whiting	*Siphonognathus attenuatus* (Ogilby)
Dragonet	*Bovichthys variegatus* (Richardson)
Macleay's Threefin	*Norfolkia striaticeps* Ramsay & Ogilby
Crested Weedfish	*Cristiceps australis* Cuvier & Valenciennes
Forsters Weedfish	*Heteroclinus forsteri* (Castelnau)
Johnston's Weedfish	*Heteroclinus johnstoni* (Saville-Kent)
Orange-spotted Goby	*Nesogobius hindsbyi* (McCulloch & Ogilby)
Castelnau's Goby	*Nesogobius pulchellus* (Castelnau)
Girdled Goby	*Nesogobius* sp.
Tasmanian Clingfish	*Aspasmogaster tasmaniensis* (Günther)
Seagrass Clingfish	*Parvicrepis* sp.
Painted Stinkfish	*Eocallionymus papilio* (Günther)
Long-snouted Flounder	*Ammotretis rostratus* Günther
Greenback Flounder	*Rhombosolea tapirinia* Günther
Bridled Leatherjacket	*Acanthaluteres spilomelanurus* (Quoy & Gainard)
Velvet Leatherjacket	*Eubalichthys gunnii* (Günther)
Brown-striped Leatherjacket	*Meuschenia australis* (Donovan)
Toothbrush Leatherjacket	*Penicipelta vittiger* (Castelnau)
Cosmopolitan Leatherjacket	*Parika scaber* (Günther)
Shaw's Cowfish	*Aracana aurita* (Shaw)
Porcupine Fish	*Diodon nicthemerus* Cuvier